SOUTHERN POWER AND INDUSTRY

FEBRUARY, 1951

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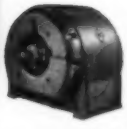

ONE MAN can perform all routine maintenance jobs on this brand new line of Allis-Chalmers large motors. He can remove the upper halves of the end brackets and air baffles and reach right inside the motor with his vacuum cleaner or air hose. There is plenty of room to reach up back of the stator core through air discharge openings in the stator yoke.

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Volume 69 Number 2

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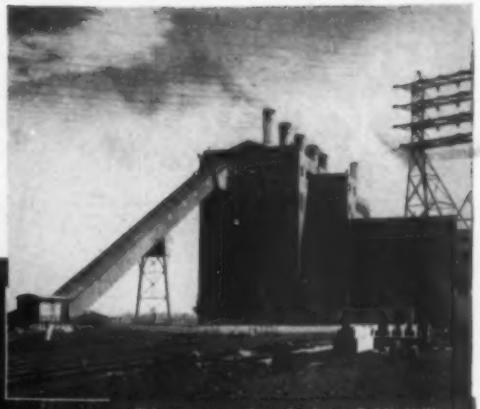

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SOUTHERN POWER AND INDUSTRY

FEBRUARY 1951

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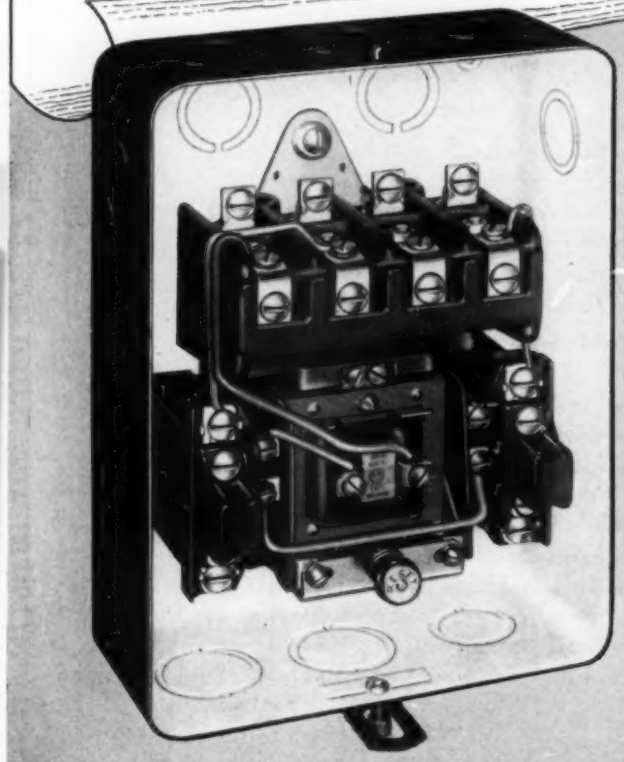
Charles C. Colton



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Facts and Trends

FOR SOUTHERN INDUSTRIAL AND POWER EXECUTIVES

February, 1951

FUEL FOR INDUSTRY--Thirty years ago industry depended largely on coal for fuel. Petroleum and natural gas supplied only about 20% of the total demand. In 1915 sources of energy were divided as follows: coal 81.9%; petroleum 10.2%; natural gas 4%; and water power 3.9%. During the period of 1915 to 1949, energy from petroleum increased seven-fold, from natural gas nine-fold.

The 1949 statistics of the nation's total fuel energy were reported by W. M. Carney of the Lion Oil Company at the Petroleum Electric Power Assoication annual meeting at Hot Springs, Arkansas; petroleum accounted for 36.4%; natural gas 19.4%, making a total of 55.8% for both oil and gas. Coal contributed 39.3% and water power 4.9%. On a per capita basis, the change appears even more significant. Coal consumption has declined, per capita, while oil has increased to 600 gallons annually, and natural gas to about 35,000 cu ft. About 25% of our fuel goes for domestic and commercial heating, transportation demands 32%, and the remaining 45% is used to power the nation's industrial plants.

MACHINES, MATERIALS AND DEVICES never actually reach an ultimate state of development, although at the time it is difficult to see how further improvement is possible. The 1920 edition of the WESTINGHOUSE ENGINEER spoke with pride of a 60,000 kw steam-generating unit, a 32,500 kva waterwheel generator, and seven 16,667 kva transformers for a 220 kva line. Circuit breakers had interrupted 600,000 kva on a 13.2 kv circuit. The electrical equipment for the locomotives of a d-c electrification were spoken of as being "well-nigh perfect".

The 1951 January edition emphasizes new records for size. High-speed turbine generators have reached 150,000 kva, and circuit breakers have interrupted 10,000,000 kva. Long-standing good ideas seem to have "turned the corner", like the rectifier locomotive and the series capacitor for transmission lines. There is a good crop of new materials, such as Thermalastic insulation for central station generators, several new plastics for sealing electronic components from moisture, an oxygen-inhibited oil for transformers, and the new Coastal finish for distribution transformers that is far more resistant to salt and corrosive atmospheres. The magnetic amplifier has risen to new heights and the microsyn holds promise of a bright future.

INTERESTING ELECTRICAL TRENDS are also featured in the January GENERAL ELECTRIC REVIEW. Power transformer developments note a new core design in which the core has only one joint per lamination. An almost ideal magnetic circuit results. A new electrolytic capacitor, the Tantalytic, is even smaller than conventional aluminum electrolytics. A large wide-range adjustable-frequency constant-horsepower drive incorporates a 30,000 hp motor. A new type low-voltage switchboard, pre-fabricated of standardized parts, was designed to centralize power and lighting switching in one dead-front free-standing package.

The world's largest coal-loading shovel--with a 16½ cu yd dipper, 85 ft boom, and capacity of approximately 30 tons a minute went into operation. Five passes of the shovel are all it requires to load a standard 75 ton coal car, with an average of approximately 35 seconds per pass. The lumber industry was given an amplidyne-controlled veneer lathe drive which automatically peels veneer from longs at constant linear sheet speed, compensating for the reduction in log diameter as peeling proceeds.

ANALYSIS OF CENTRAL STATION STEAM TURBINES in sizes 10,000 kw and larger, shipped from G.E. 1947 through 1950 shows interesting trends. In 1950 more than 28% of kilowatt capacity was for 951 F to 1050 F, and 43% was for 1251 lb or more pressure, including 12% for pressures between 1451 and 2000 lb. Resuperheat accounted for 26.6 total kw capacity during the year. Average size of turbines increased from 35,565 kw in 1947 to 52,088 kw in 1950. All of these trends point to increased efficiency--more kilowatts per pound of fuel.

THE MODERN CONTROL PANEL has become the nerve center of the whole plant's operation. It is the medium for tying together all of the electrical and mechanical devices and instruments necessary for the correlated functioning of the entire process or power plant. THE GRAPHIC PANEL gives industry a powerful tool for the continuous operation of complex processes. The plant operator can visualize the conditions throughout the entire unit. When conditions change, or equilibrium is disturbed, he traces the disturbance through the whole process and operates the plant as a unit.

E. I. du Pont de Nemours & Company's Sabine River Works at Orange, Texas, utilizes over 150 control panels of this type. In the March issue of SP&I, A. V. Novak, of the Orange, Texas plant will discuss the development of automatic control panels from local boards, through central control rooms, consoles, and finally to the new graphic panel. Advantages and disadvantages are discussed. Approximate cost and space comparison will be made with conventional panel boards.

MORE STEEL FOR THE SOUTHEAST--the ATLANTIC STEEL COMPANY of Atlanta, Georgia has launched a three-year expansion program that will increase its steel-making capacity 50 per cent and double its output of rolled products. The new program follows on the heels of a $2 million four-year post-war modernization and improvement program that has greatly widened the scope of products, facilities and services.

First phase of the three-year program will be the installation of a 60 ton electric furnace at a cost of approximately $1,500,000. It is estimated that the new furnace will produce a minimum of 100,000 tons of steel annually. Present rated capacity of Atlantic's three open hearth furnaces is 188,000 tons. However, in 1950, Atlantic produced more than 200,000 tons of steel. Second phase of the company's expansion will be the addition of a new rolling mill. The entire program will be financed by PRIVATE CAPITAL, according to Robert S. Lynch, president of the company.

INDUSTRY WILL LOOK SOUTHWEST in March for the INTERNATIONAL INDUSTRIAL EXPOSITION. Power and industrial equipment for all general industrial, power and large service plants will be featured at the Coliseum, Houston, Texas, March 11-17th. Admission will be free by tickets that can be obtained from manufacturers exhibiting or by writing Mr. Ed. G. Lenzner, General Manager, 41 San Jacinto St., Houston 2, Texas.

PADUCAH, KENTUCKY'S $350,000,000 uranium-235 production facility, being built on the site of the Kentucky Ordnance Plant, will be operated by The Carbide and Carbon Chemicals Division of the Union Carbide and Carbon Corporation, which operates the U-235 production plant at Oak Ridge, Tennessee.

The Atomic Energy Commission's new production plants in South Carolina near the Savannah River will be designed, built and operated by the E. I. du Pont de Nemours Company. While having a primary military purpose at this time, the new AEC plant will add to the nation's capacity for producing "fuels" which someday will be needed to provide atomic energy for useful power.

Write the editors for additional information on any of the above items.

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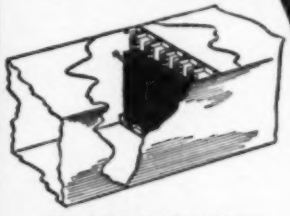
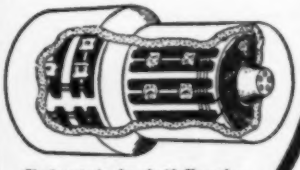


Chromalox Electric Fin-Strip Heaters mounted in air ducts.



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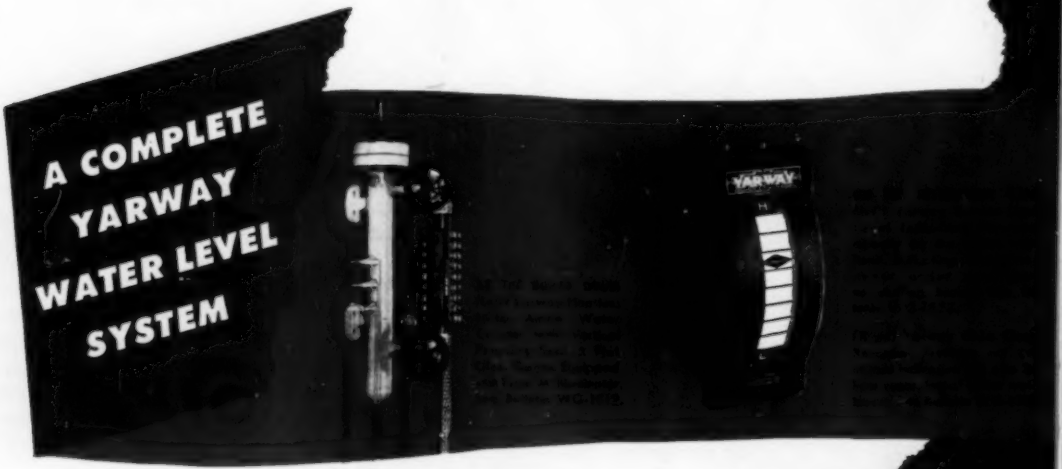

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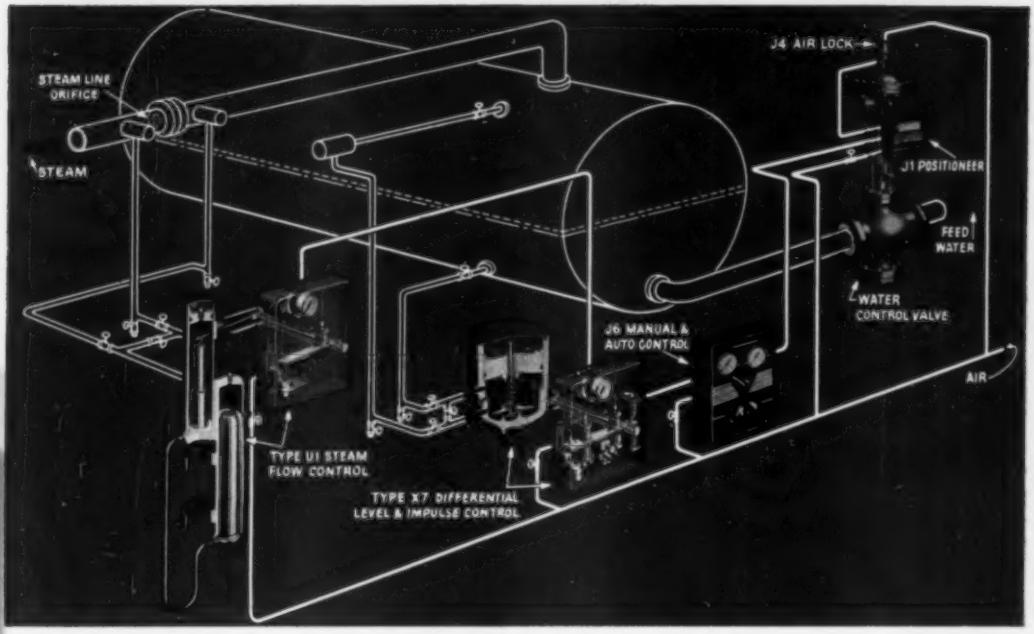

SWARTWOUT two-element controls—by utilizing the very forces that cause false drum level—produce a corrective impulse that assures correct level even under rapid load swings. Since "shrink" and "swell" are functions of *rate of change*, as well as magnitude of load, only Impulse Regulation gives satisfactory operation under *any rate of change in load of any magnitude.*

Type U1 flow transmitter takes square root of steam line orifice differential and feeds airloading pressure, which is directly proportional to steam flow at all flows, to X7 differential level and impulse control. X7 unit positions flow valve by sending airloading pressure which is result of combining *rate of change* of steam flow function with water level.

Graph *(right)* shows how proper combination of these forces, plus reset and setback features, assures that valve will give desired operation under *any* load condition. System can be adjusted to maintain drum level constant at all loads, carry it high at high loads, low at low loads, or vice versa. In addition to this FW6 two-element system, Swartwout also makes an FW7 three-element impulse regulating system. Other types include FW5 single-element system and SC (FW1) thermo-hydraulic system.

A-3703

Swartwout

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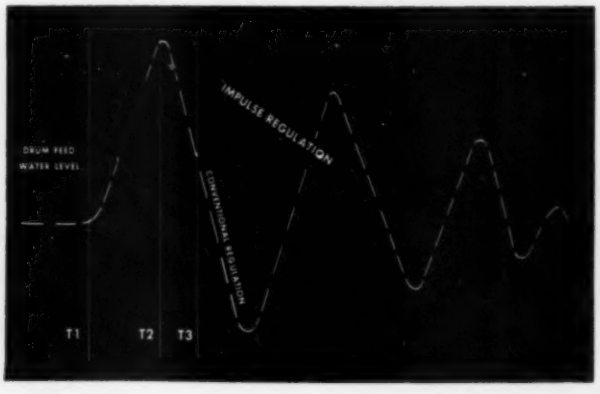

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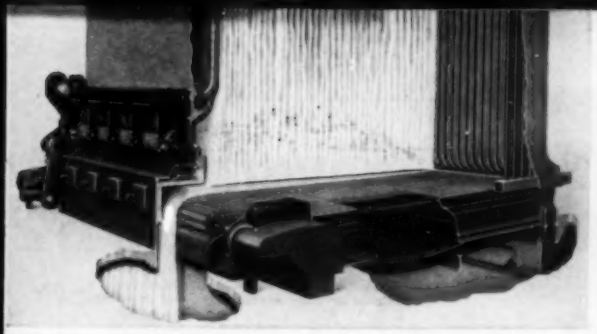

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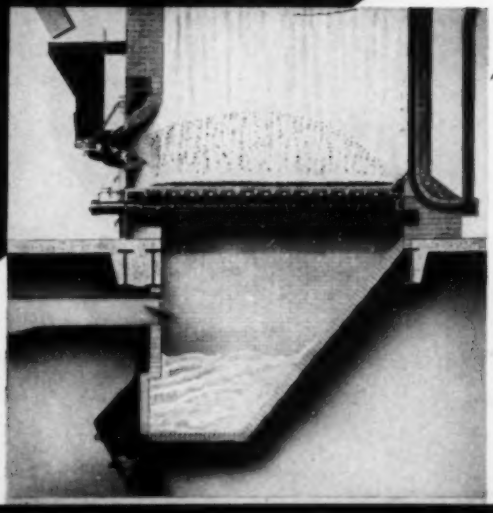

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- — the electrical load, or power requirement, of a forced draft fan is at a minimum, because the fan handles a lesser volume of air.
- — low fan maintenance and longer fan life with forced draft fans since they operate with cool, clean boiler room air — no problems with high bearing temperatures and corrosion.
- — air is under pressure in the combustion chamber of a forced draft boiler, with no possibility of "diluting" air entering the chamber. Maximum boiler efficiencies are always attained when head plates and casings are tight.
- — lower initial fan cost, better space arrangement, and better appearance are gained because forced draft fans are considerably smaller.
- — casings for forced draft fans are cool — require no insulation — contribute to safer operation and cooler boiler rooms.

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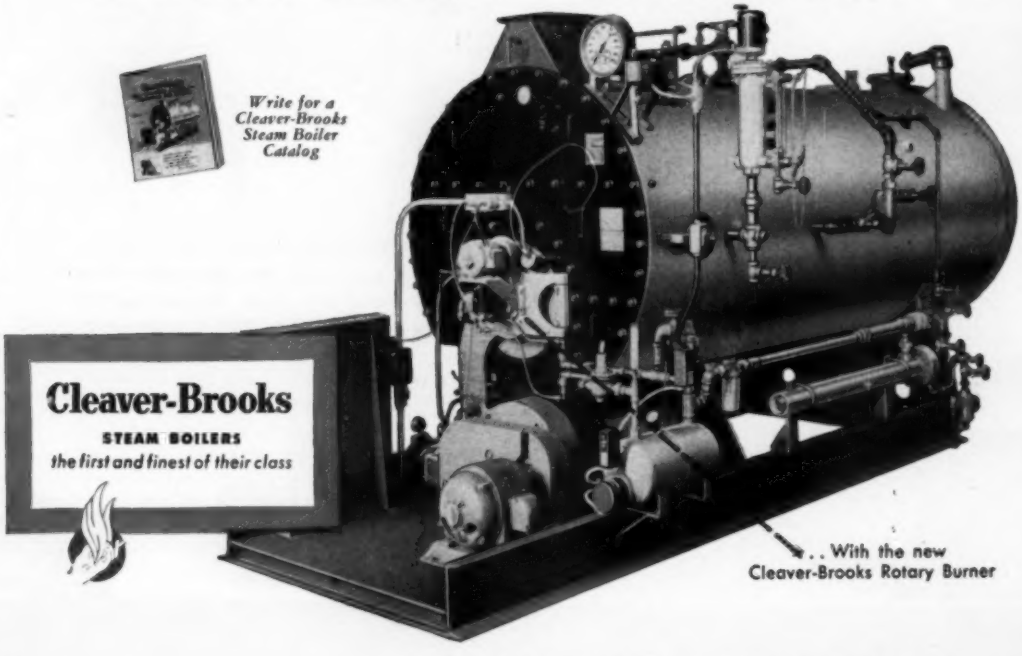

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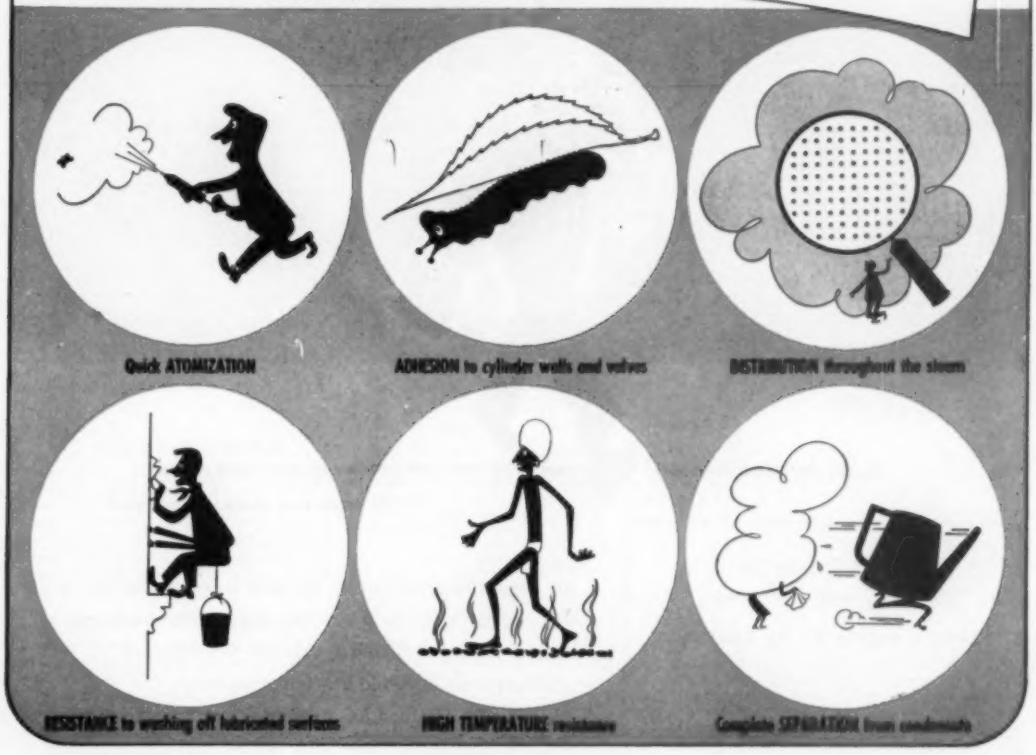
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800	833	845	851	858	870	1006	1007	1010	1020	1021	1049	860	811	812	813	814
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Equipment and Review Editor
SOUTHERN POWER & INDUSTRY
806 Peachtree St., N. E.
Atlanta 5, Ga.

You can't install a *better* valve than a POWELL VALVE —there IS no better!

Over a century of concentration on making one—and only one—kind of equipment must have a definite result. With Powell, the result is not only an amazingly complete* line of valves for industry but also the *best* valves it is possible to make.

*Powell Valves for Power Plants include not only a complete line of standard valves of all types but also many special designs to meet the latest requirements of modern power services.

Quality fine throughout "The Line"

Fig. 1793. A large 125-pound Iron Body, Bronze Mounted Gate Valve for low pressure steam, oil, water and gas services.

POWELL

The WM. POWELL CO., 2525 Spring Grove Ave., P. O. Box 106, Station B, Cincinnati 22, Ohio

it's New!

it's Different!

it's the strongest pipe wrench in the world!

–the revolutionary Walworth improved Walco®

Yes, this is it . . . the NEW Walworth *Improved* Walco pipe wrench—with every part scientifically designed and tested by engineers for strength, safety and ease of operation. Its instant bite, and accurately determined center of gravity, combine with its inherent strength and minimum of weight to make it the fastest-working, easiest-handling, best balanced, heavy-duty pipe wrench available today . . . a wrench specially designed to minimize operator fatigue.

All parts are made of forged steel. The housing and handle are projection welded—a structural weld—to form an integral unit. Both jaws are carefully machined, and all parts are heat-treated to give extra toughness, uniformity, and strength. Every Improved Walco far exceeds the requirements for Federal Specification GGG-W-651a for Type II Heavy Duty Adjustable Pipe Wrenches.

A flexible, double-acting, easily replaceable spring—an exclusive patented Improved Walco feature—gives the wrench fast, positive ratcheting action!

Ask your Walworth distributor about the new, Improved Walco today! Heft the new, Improved Walco . . . feel its perfect balance—every part is guaranteed by the Walworth Company, doing business since 1842.

Check these outstanding features

LIGHTER: Housing and Handle are projection welded to form one integral unit.

CORRECT BALANCE: Accurate, the correct location of the center of gravity determined by test.

STRONGER: Heat treated to eliminate brittleness . . . cracking.

FAST ACTING: Scientifically designed spring action insures positive ratcheting action . . . quick bite.

CALIBRATED PIPE SCALE: Built-in scale permits speedy adjustment to pipe size.

RENEWABLE PARTS: All parts are readily obtainable, and easily replaced without special tools; thus prolonging service life indefinitely.

RUST RESISTANT FINISH: Entire wrench is rust resistant—Nut and Jaws have a special electroplated zinc coating.

WALWORTH

valves...fittings...pipe wrenches

60 EAST 42nd STREET, NEW YORK 17, N. Y.

DISTRIBUTORS IN PRINCIPAL CENTERS THROUGHOUT THE WORLD

DIXISTEEL
BARS AND SHAPES

Southern made for Southern needs

More and more Southern manufacturers and fabricators are using DIXISTEEL Bars and Shapes than ever before.

Made from our own high-quality, open-hearth steel, DIXISTEEL Bars and Shapes meet the most exacting requirements. They are produced in a wide variety of shapes, sizes and grades—plain or galvanized.

Write today for complete information and prices.

Atlantic Steel Company

MAKERS OF DIXISTEEL SINCE 1901

ATLANTA, GEORGIA

GOOD QUALITY STEAM

even at concentrations above 15,000 parts per million!

You may find it hard to believe that good quality steam can be produced with boiler concentrations in excess of 15,000 parts per million. But look at this analysis of samples from a Southwestern refinery power plant.

HERE'S PROOF!

THE BIRD-ARCHER COMPANY
NEW YORK 17, N. Y.

PHILADELPHIA 40, PA.
LABORATORY AND PLANT
437 NORTH AMERICAN STREET

GENERAL OFFICES
400 MADISON AVENUE

CHICAGO 11, ILL.
WRIGLEY BUILDING

Date April 27, 1950

CHEMICAL ANALYSIS

Results expressed in [illegible] parts per million

SAMPLE MARKED	Boiler Make-Up (Raw)	Condensate	Boiler Feed	Boiler #5	Boiler #8		
ANALYSIS NUMBER 500,10							
Total Dissolved Solids	1002	6	612	15980	13992		
Suspended Solids	Trace	0	8	1052	332		
Carbonate Hardness ($CaCO_3$)							
Non Carbonate Hardness ($CaCO_3$)							
Total Hardness ($CaCO_3$)	36	0	20	0	0		
Calcium ($CaCO_3$)	24						
Magnesium ($CaCO_3$)	12						
Sodium (Na)							
Silica (SiO_2)	13		7	88	88		
"P" Alkalinity ($CaCO_3$)	0	0	8	1520	1410		
"M" Alkalinity ($CaCO_3$)	168	4	112	2160	1910		
"OH" Alkalinity ($CaCO_3$)			0	1030	1020		
Chlorides (Cl)	420	0	256	5900	5240		
Sulfate (SO_4)	27	0	12	224	212		
Phosphate (PO_4)		0	0	60	55		
Nitrate (NO_3)							

Caustic embrittlement observations have been made at this plant for more than ten years with continual negative findings.

HOW? **with CONCENTROL**

Bird-Archer's new Concentrol was specially developed to eliminate foaming and boiler water carryover due to high alkalinity, dissolved solids, suspended solids or any combination of them.

Concentrol works by effecting a rapid change in surface tension of steam bubbles which permits coalescence of small steam bubbles into bubbles of larger size. This results in the formation of unstable bubble films which break readily upon reaching the steam disengaging surface of the boiler water, thus eliminating foam build-up and subsequent boiler water carryover.

Concentrol is available in several different formulations, some of which contain selected tannins, which condition boiler water sludge and suspended matter, maintaining them in a highly fluid, non-adherent form. Concentrol may be safely fed through feedlines and when fed continuously will help inhibit feedline deposits.

For full details on economical, efficient Concentrol, send for Data Sheet. For recommendations on your specific problem, consult your nearest Bird-Archer representative. Or, write direct to Bird-Archer outlining the details of your boiler operation.

BIRD-ARCHER
WATER TREATMENT

THE BIRD-ARCHER COMPANY, 400 MADISON AVE., NEW YORK 17, N. Y.
PHILADELPHIA • CHICAGO
IN CANADA: The Bird-Archer Co., Limited, 503 McGill Building, Montreal, Canada
IN MEXICO: Calderas y Accesorios, S. A., Amsterdam 291, Mexico, D. F.

LABORATORIES · ENGINEERS · CHEMISTS

BA-150

PROVED IN PERFORMANCE

Grinnell-Saunders Valves with CHEMICALLY INERT KEL-F* DIAPHRAGMS

Pat. App. For

Grinnell-Saunders Diaphragm Valves with KEL-F Diaphragms are living up to every promise made for them! At the right are reports from typical users.

KEL-F's resistance to chemical action, low cold flow, wide range of temperature application and exceptional flex life combine to make it the most important diaphragm development in years. KEL-F is chemically inert to all organic acids and alkalies in all concentrations. It withstands chlorinated aliphatic and aromatic compounds, concentrated nitric, chromic, hydrofluoric and sulphuric acids and most solvents which readily attack rubber and previous synthetic diaphragm materials.

While KEL-F is tough and flexible, it is not resilient. To provide resiliency for proper closure of the valve and to provide added support for the KEL-F diaphragm, it is backed with a rubber cushion. A free-floating method of attachment to the compressor assures an even closing pressure on the entire surface of the weir. A tube nut which floats as the rubber cushion presses down in closing the valve, eliminates excessive pressure on the diaphragm stud. The rubber cushions the closing force, thereby reducing wear and cutting action on the diaphragm. In accelerated tests, a 2-inch valve with a KEL-F diaphragm withstood over 80,000 closures, drop tight, against 80 pounds of air under water with no leakage and no visible signs of wear. Write for complete information.

Typical performance reports . . .

1. Chlorine and HCl gas with small amounts of acetic acid and acetyl chloride at 302° F. for 900 hours. Very much superior to material it replaced.

2. Mixed aromatic and ketone solvents at 230° F. and 10 psi for three months. No sign of deterioration.

3. Chlorinated organic chemical at 158 to 194° F. and 30 to 40 psi for nine months. No failure, no shutdown, no replacement.

4. Chromyl chloride at ambient temperature and 15 psi. Diaphragm condition good at end of thirty days' test.

5. Liquid chloral saturated with HCl at 158° F. for 408 hours. Well satisfied — have placed orders for additional diaphragms.

*"KEL-F" is the registered trade name for polytrifluorochlorethylene, an exceptionally stable thermoplastic. It is produced by the M. W. Kellogg Co.

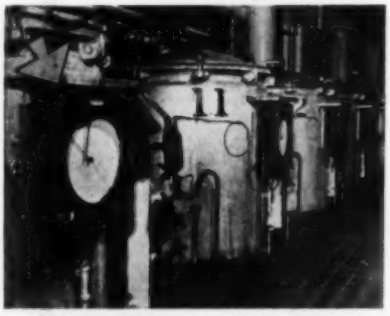
GRINNELL

WHENEVER PIPING IS INVOLVED

GRINNELL COMPANY, INC., Providence, R. I. Warehouses: Atlanta • Billings • Buffalo • Charlotte • Chicago Cleveland • Cranston • Fresno • Kansas City • Houston • Long Beach • Los Angeles • Milwaukee • Minneapolis • New York Oakland • Philadelphia • Pocatello • Sacramento • St. Louis • St. Paul • San Francisco • Seattle • Spokane

Cooking of Swift's **PARD** is automatically regulated by **POWERS** TEMPERATURE CONTROL

SWIFT & CO.
guards PARD quality with
POWERS

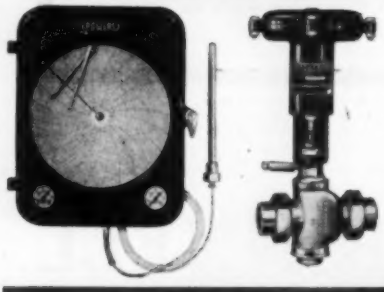


Temperature Recording Regulators on Cooking Retorts

One of the important steps insuring PARD'S uniformly high nutrient content, taste, color and odor is accurate temperature control of cooking operations. Powers instruments are used here on cooking retorts in which Pard is processed.

Other processes and operations in Swift & Co. plants regulated by Powers controls are:

Large Water Heaters • Booster Heaters for Sterilizing • Hog Scalding Vats and De-hairing Machines • Cooking Vats, Kettles and Sausage Steaming Cabinets • Smoke Houses • Drying, Curing and Chilling Rooms • Slicing and Packaging Rooms—and Many Processes in By-Product Plants.



If you have a problem of temperature or humidity control, contact your nearest POWERS office. There's no obligation. With almost 60 years of experience and a wide variety of pneumatic and self-operated controls we may be able to help you select the best equipment for your requirements.

[SCR]

THE POWERS REGULATOR CO.

"This Steam Trap is unconditionally guaranteed to satisfy you!"

YOU CAN'T LOSE

SAVED 2728 GALLONS OF FUEL OIL in one year after replacing old traps with Armstrongs on kettles, low pressure heating system and cream beaters.—*Mary Lincoln Candies, Buffalo, New York.*

30% LESS MAINTENANCE with Armstrong traps on heating and steam distribution system.—*John Deere Harvester Works, East Moline, Ill.*

COOKING KETTLE OUTPUT SPEEDED UP 30% by Armstrong trapping on each steam jacketed kettle.—*Bulman's Ltd., Vernon, B. C.*

EVERY Armstrong steam trap is guaranteed to be free from defective workmanship or material, to function perfectly, to fulfill all claims in every respect and to give complete satisfaction.

ONLY A GOOD STEAM TRAP COULD *POSSIBLY* BE BACKED BY SUCH A GUARANTEE! To save fuel, to reduce maintenance, to get more work out of existing equipment, to get complete steam trap satisfaction, ask your nearby Armstrong representative to discuss with you the traps you need now.

ARMSTRONG MACHINE WORKS
806 Maple St., Three Rivers, Mich.

SEND FOR YOUR COPY OF THE 36-PAGE ARMSTRONG STEAM TRAP BOOK explaining the design and workmanship that make the Armstrong guarantee possible. Complete data on the selection and installation of traps for all classes of equipment. Free on request.

ARMSTRONG STEAM TRAPS

is

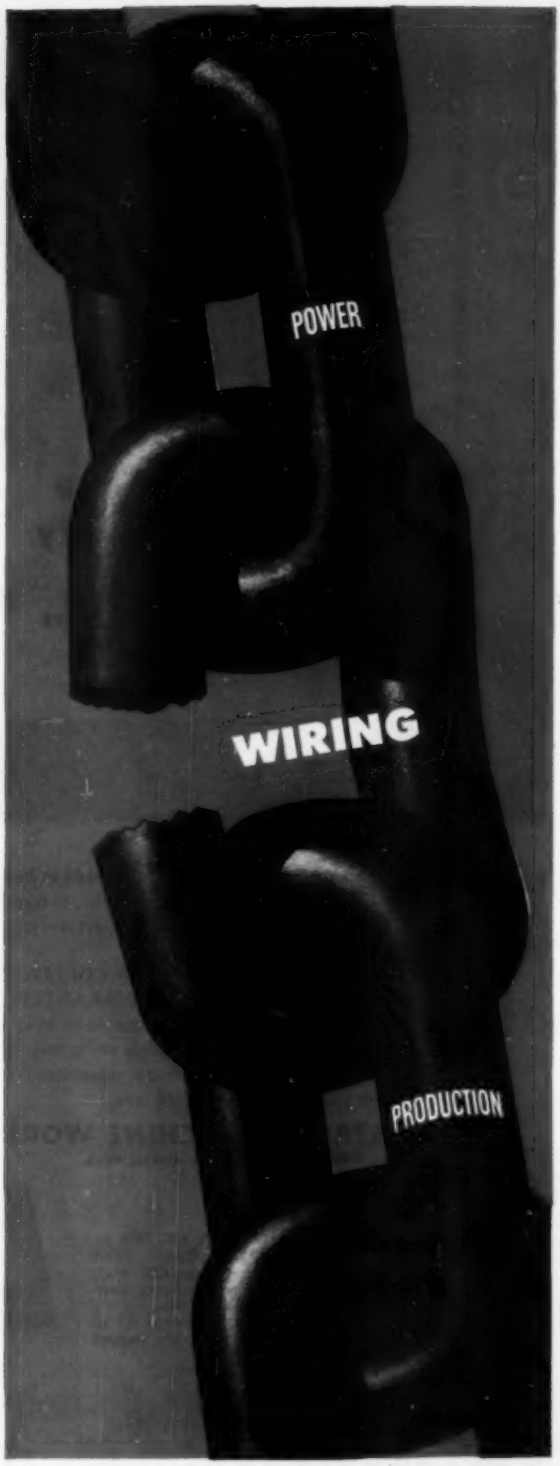
overloaded wiring

breaking

your

production

chain?



Your plant wiring may be the weak link in your production chain.

When the voltage drops at your machines, those machines slow down—and so does their production! This is happening in 9 out of 10 industrial plants—all because they're equipped with obsolete, inadequate wiring systems.

You're paying for power – make sure you make full use of what you pay for. A *modern* plant wiring system delivers to the machine the power you pay for at the meter . . . and guards you against costly power loss.

Today more than ever full-scale production is vitally important to our national defense. Strong national defense requires full production . . . and full production requires an adequate wiring system. Call your plant, utility or consulting engineer or your electrical contractor today and make arrangements to have him survey your wiring system.

Most important of all, send for your free copy of *"Power Up—And Be Prepared."* This complete modern wiring guide shows you how you can determine quickly and easily the exact condition of your plant wiring system. Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

S1358

the right cable for the job

ANACONDA®

WIRE AND CABLE

YOUR MOST IMPORTANT RAW MATERIAL

In many industrial plants, water is, literally, the most important raw material. It is used at virtually every stage of manufacture and the total volume required exceeds that of any other material.

Industrial water, important in terms of volume, is even more important because it is expensive—not in dollars per million gallons but in dollars per unscheduled outage of a boiler, dollars per cleaning of a heat exchanger, dollars per day's production of textiles sent back for re-dyeing.

To reduce the high cost of these "hidden taxes" imposed on the use of water for boiler feed, for cooling or for process use requires more than legislative debate or executive order—it requires the objective collection and interpretation of facts, frequently beyond the apparent limits of the immediate problem.

Through long experience with water problems of all kinds, in industrial plants of all types, Hall Laboratories is equipped to deal with your water problems on a *plant-wide* basis, from selection of source to waste recovery and disposal. Hall engineers recommend detailed procedures which represent not only the best solution to the individual problem but also the greatest contribution to over-all efficiency and economy in your use of water.

If you are concerned with any industrial use of water, you will be interested in the new Hall Bulletin "Your Most Important Raw Material." May we send you a copy?

Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pennsylvania.

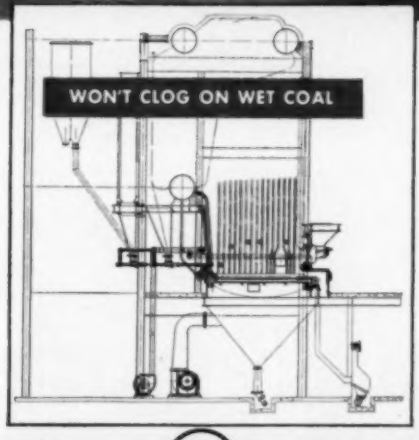
HALL *plant-wide* WATER SERVICE

BOILER WATER CONDITIONING

PROCUREMENT, TREATMENT, USAGE AND DISPOSAL OF INDUSTRIAL WATER

TOP EFFICIENCY FROM LOW AND HIGH ASH COALS

PERFECT SPREAD STOKER



Three AE Perfect Spread 2-feeder, travelling grate Stokers recently installed by a leading pharmaceutical manufacturer in the midwest. The boilers, each with a maximum continuous capacity of 60,000 lbs. per hour are Union "A" Type. Efficiency at normal capacity, 83.4%; at maximum capacity, 82.4%. Consulting Engineer, Austin Company.

In the Boiler Room illustrated, the Perfect Spread Stokers were guaranteed to use coal containing either 13,306 B.T.U. or 11,327 B.T.U. per lb. as fired. These two coals have moisture contents of 4.7% and 10.7%, with ash content of 8.2% and 10.1%, respectively. With either coal, practically the same capacity is available but these Perfect Spread Stokers have done even better than predicted. Five different grades of coal have been used to date . . . and all with top efficiency.

Perfect Spread's unique feeder won't clog on wet coal but feeds uniformly—not in slugs—regardless of moisture content. Its engineered cinder return and adjustable overfire air system give comparable results from either low or high ash coals. Its even feed characteristic insures higher CO_2, freedom from smoke puffs, minimum carbon in the ashpit, and less fly ash. Feeders adjustable from 50 to 7,500 lbs. of coal per hour . . . capacities range from 8,000 to 500,000 lbs. of steam per hour. Mail coupon today for full data.

AE

AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNA.

AE Products are: Taylor and Perfect Spread Stokers, Marine Deck Auxiliaries, Hele-Shaw and Hydramite Fluid Power, Lo-Hed Hoists, Lo-Hed Car Pullers

American Engineering Company
2421 Aramingo Ave., Philadelphia 25, Pa.

Gentlemen: We are interested in saving fuel dollars. Kindly send booklet giving full information about Perfect Spread Stokers.

Name ..... Title .....

Company .....

Address .....

City ..... Zone ..... State .....

INCREASE PRODUCTION NOW...

WITH *Present Plant Manpower*

Present Plant Space

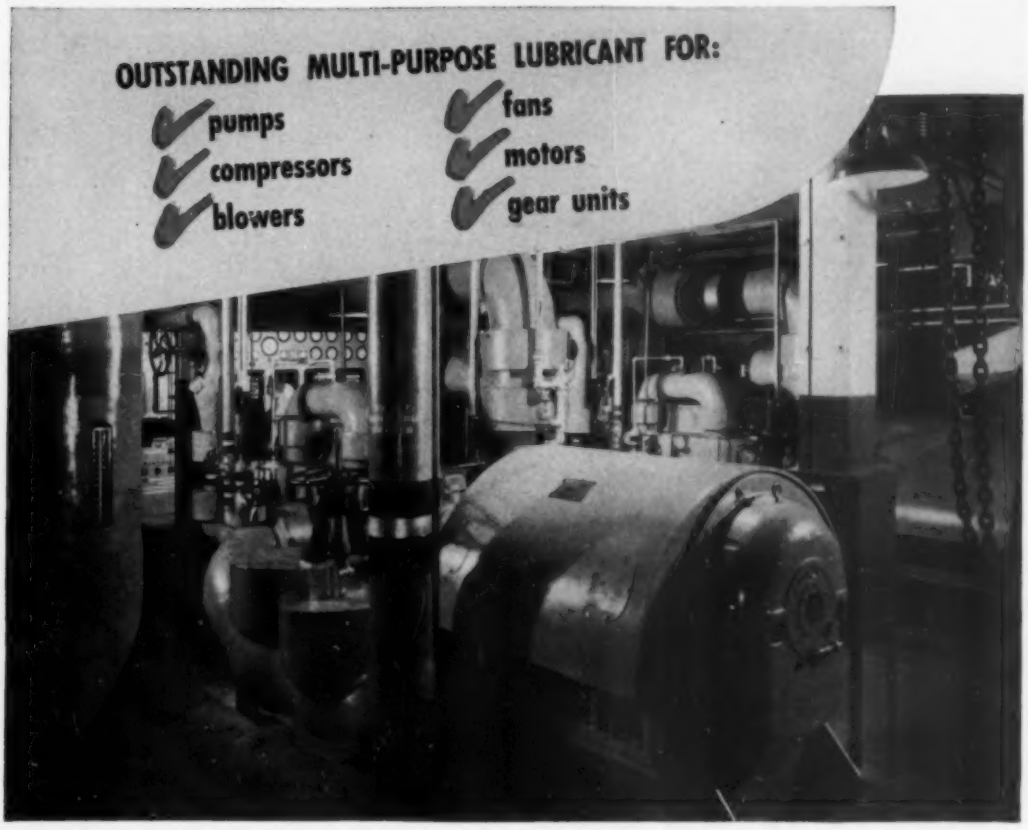
The next time you walk through your plant, cast your eyes toward the ceiling and you'll realize that there is mighty valuable space that can be put to work—without increasing your plant capacities and without increasing plant manpower.

An American MonoRail engineer will show you how you can use your "air rights". With thousands of overhead handling installations from which to draw, each with many money and time saving advantages, it will pay you to investigate American MonoRail Overhead Handling Systems. Send for bulletin C-1.

THE AMERICAN MONORAIL COMPANY

13105 ATHENS AVENUE **CLEVELAND 7, OHIO**

Cut maintenance costs with Gulf Harmony Oil_



Gulf Harmony Oil is a top quality multi-purpose lubricating oil, ideal for sleeve-type bearings, oil-lubricated ball and roller bearings, hydraulic systems, compressor cylinders, and many types of gears.

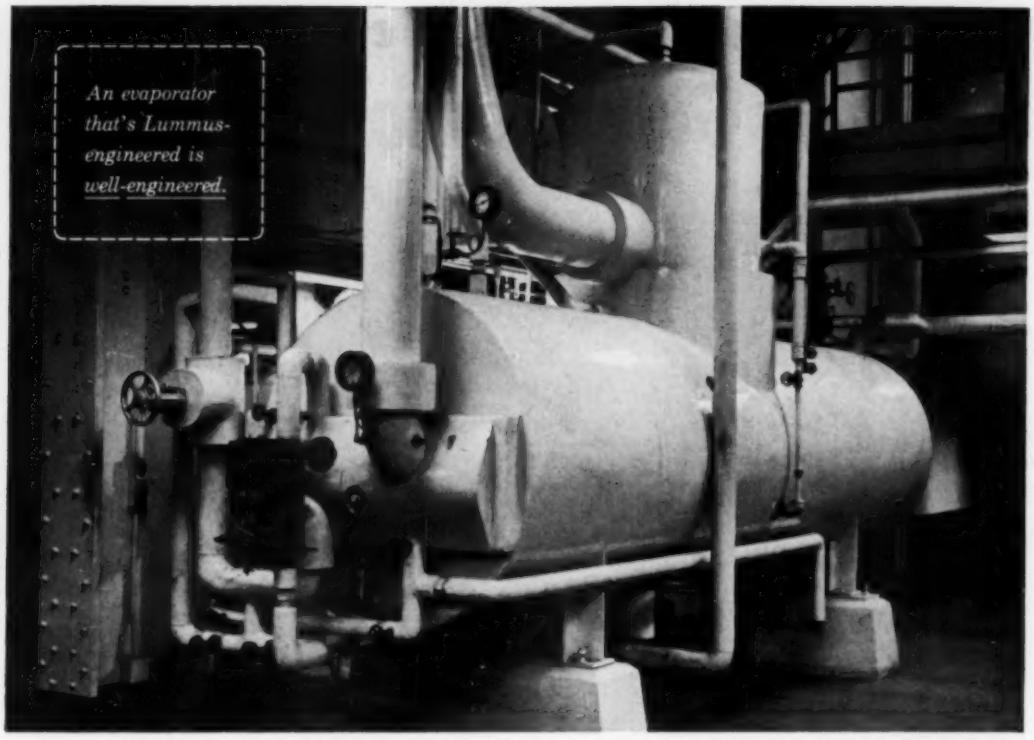
Because of outstanding oxidation stability, Gulf Harmony Oil has exceptional resistance to sludging. In force-feed circulating systems, oil reservoirs, hydraulic lines, and antifriction bearings, the use of Gulf Harmony Oil helps prevent harmful deposits, insures fewer oil changes.

Gulf Harmony Oil provides a protective film which has preferential wetting characteristics for metal—displaces moisture, interrupts its corrosive action. Thus Gulf Harmony Oil eliminates rust on all oil-bathed surfaces—particularly important in antifriction bearings operating under damp conditions. And it separates readily from water, reducing the possibility of emulsification.

Its high lubricating value means more effective protection against wear under boundary conditions. Available in a wide range of viscosities.

For complete information on Gulf Harmony Oil and for expert help on any lubrication problem, call in a Gulf Lubrication Engineer today. Gulf Oil Corporation · Gulf Refining Company, Gulf Building, Pittsburgh 30, Pennsylvania.

FIFTY YEARS OF SERVICE
1901 GULF 1951
PETROLEUM AND ITS PRODUCTS



An evaporator story that waited 2 years to be told!

Translating requirements into equipment at the time an evaporator is built is one thing. Conducting a field test to check performance after the unit has been two years on the "firing line" is a horse of another color.

The Lummus Bubble Tray Evaporator at Rochester Gas and Electric's Russell Station—shown above—came through such a test with flying colors.

The test placed emphasis on precise determination of vapor purity on a gas-free basis. Results showed that vapor purity did not exceed 0.2 p.p.m. solids content with shell concentration at an average of 2800 p.p.m. for the test period. Of great significance is the fact that this extremely favorable purity remained stable at loads varying from 10% overcapacity down to 25% of design throughput.

This tells its own forceful story of why Lummus can guarantee evaporator performance of not more than 1.0 p.p.m. vapor purity with 3000 p.p.m. shell concentration. It also shows what's available in *plus-performance* when you look to Lummus for your heat exchanger requirements.

THE LUMMUS COMPANY

HEAT EXCHANGER DIVISION • 385 MADISON AVENUE, NEW YORK 17, N.Y.

Atlanta • Boston • Chicago • Rock Island • Cincinnati • Detroit • Ft. Worth • Houston • Tucson • Salt Lake City • Minneapolis • Pittsburgh • Rochester • Albany • St. Louis • San Francisco • Wayne (Phila.) • Athens • Buenos Aires • Honolulu • London • Manila • Toronto • Paris • Rome • San Juan, P. R. • Mexico City

Steam Surface Condensers • Evaporators • Extraction Bleeder Heaters • Steam Jet Air Ejectors • Steam Jet Refrigeration • Barometric Condensers • Heat Exchangers for Process and Industrial Use • Process Condensers • Pipe Line Coolers.

TOUGH LAYOUTS

- Assured Safety
- Efficient Operation
- Minimum Fuel Costs
- Low Maintenance
- Long, Trouble-Free Life

MADE SIMPLE BY NAVCO

The high degree of skill acquired by Navco Engineers from long experience in solving unusual Piping problems is your guarantee of an accurate and workmanlike Piping System.

Consult Navco for your next Piping Job

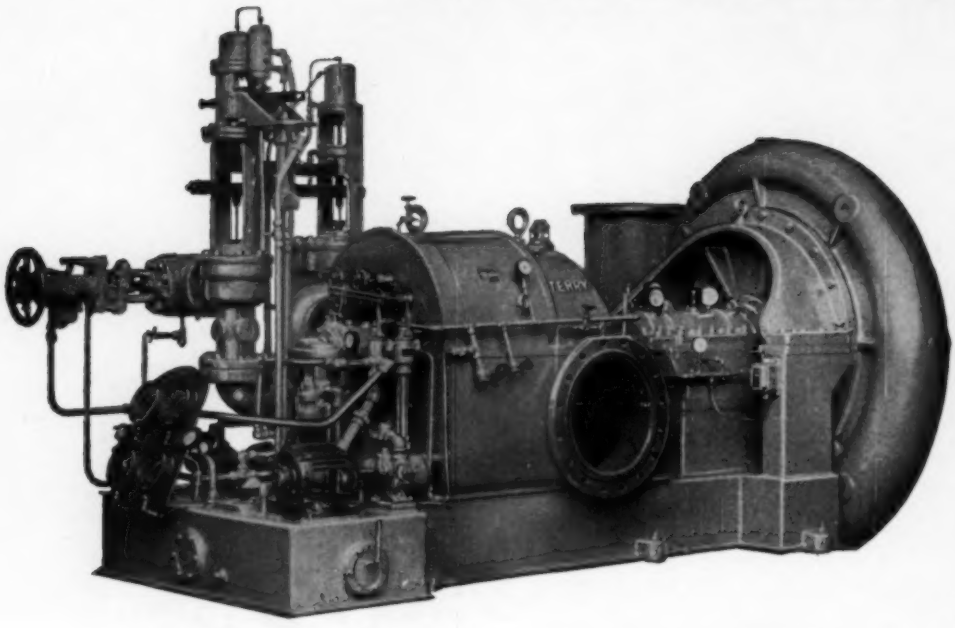
NAVCO

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO • CINCINNATI

The TERRY TURBINE



SPECIAL PURPOSE TURBINE

FOR OPERATION UNDER ALL THESE CONDITIONS:

1. Straight, high-pressure, condensing
2. Straight, low-pressure, condensing — putting to work excess low-pressure steam.
3. Mixed pressure — using the low-pressure steam available, with only enough high-pressure steam required to drive the compressor
4. Condensing bleeder operation — providing clean, low-pressure steam for heating or process work

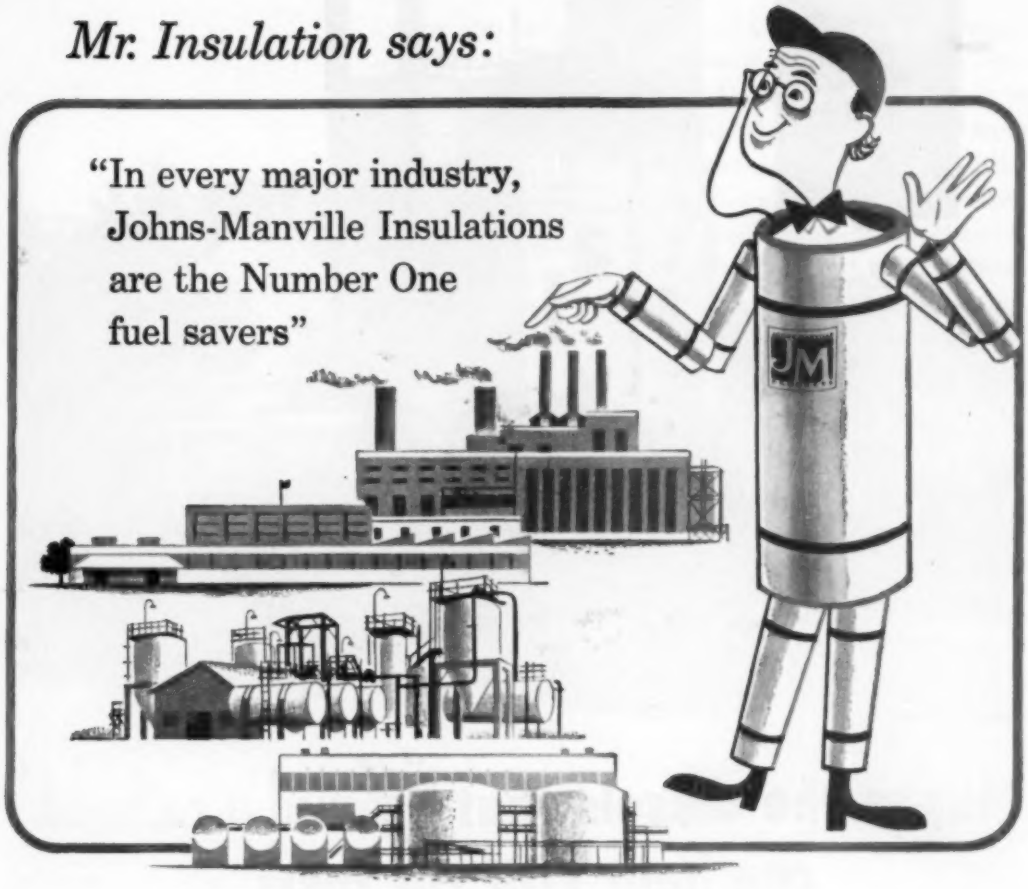
. . . and the speed under any of these conditions can be varied from 2800 to 4750 rpm.

This is but one example of many unusual combinations developed by Terry to meet out-of-the-ordinary requirements in turbines up to 2000 hp. Information on a special-purpose turbine for your specific requirements will be gladly furnished.

T1177

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

Mr. Insulation says:



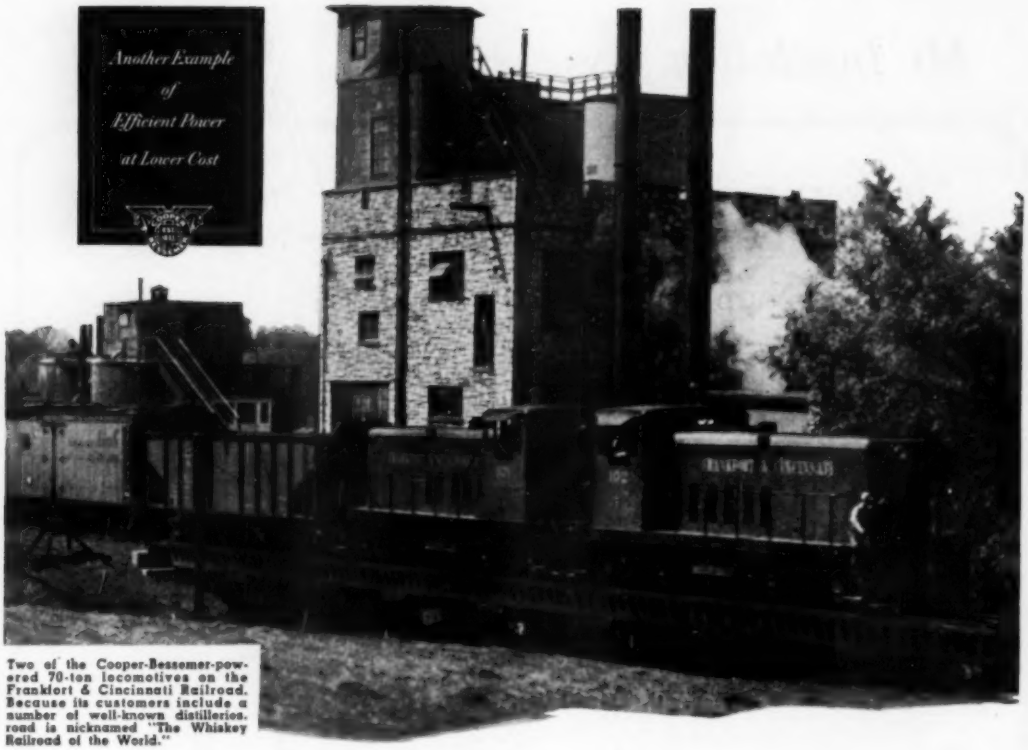
IN PLANTS with stacks or stills, tanks or towers, the story is the same—"Insulation by Johns-Manville" means the maximum return on your investment. There are two good reasons for this:

1. YOU GET THE RIGHT *MATERIALS*—From asbestos and other selected raw materials, Johns-Manville manufactures a wide range of industrial insulations for service from 400F below zero to 3000F above. If you need engineering advice in determining exactly the right one for your job, you can get experienced and authoritative assistance from your local Johns-Manville insulation engineer.

2. YOU GET THE RIGHT *APPLICATION*—Even correctly selected insulation needs proper application to permit it to serve at peak efficiency through the years. Here you can always count on J-M Insulation Contractors and their highly skilled mechanics. These organizations are trained in Johns-Manville application methods, and have generations of insulation experience behind them.

Why not get the complete picture? Call on insulation headquarters when your next job is in the planning stage. Just write Johns-Manville, Box 290, New York 16, N. Y.

Johns-Manville *first in* **INSULATIONS**



Two of the Cooper-Bessemer-powered 70-ton locomotives on the Frankfort & Cincinnati Railroad. Because its customers include a number of well-known distilleries, road is nicknamed "The Whiskey Railroad of the World."

Maybe the diesels that "Saved a railroad" can help YOU cut costs

WHETHER your plans call for stationary, marine, or locomotive power, the facts in the case of the Frankfort & Cincinnati Railroad might be your cue to big savings.

On this short-line railroad, three Cooper-Bessemer-powered 70-ton diesel-electric locomotives are now doing the work of *seven* steamers. They are giving close to 98% availability! Maintenance cost has dropped from one-half to *one-fifth* of a cent per ton mile. Fuel costs run less than half! Net result is a *full 68% cut in operating costs!* In the words of George L. Fowler, president of the railroad, "If it hadn't been for the money saved by our diesels, our road just couldn't operate."

Here is a typical example of the steady work-loads that can be carried with unmatched economy and dependability by good diesels — the kind built by Cooper-Bessemer for *all* types of heavy-duty service.

The
Cooper-Bessemer
Corporation

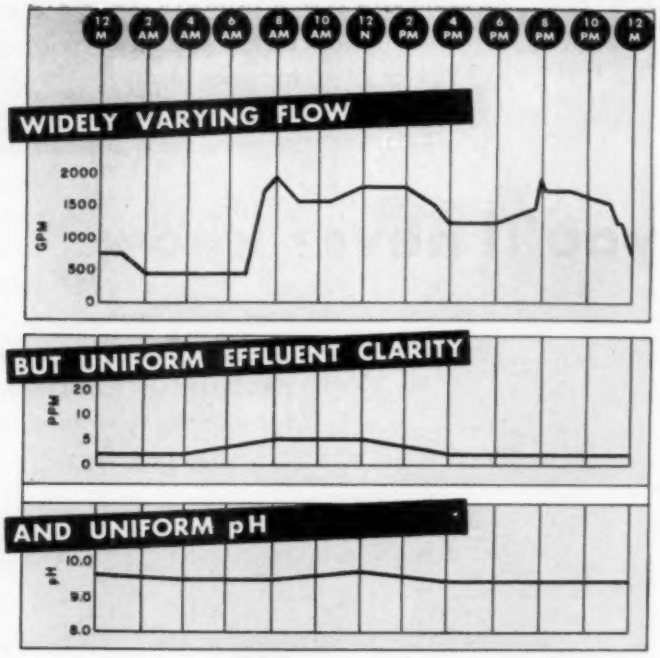
MOUNT VERNON, OHIO — GROVE CITY, PENNA.

New York Washington, D. C. Bradford, Pa. San Francisco Houston, Dallas Greggton, Pampa and Odessa, Texas Seattle Tulsa Shreveport St. Louis Los Angeles Chicago Caracas, Venezuela Cooper-Bessemer of Canada, Ltd., Halifax, Nova Scotia Gloucester, Mass. Calmes Engineering Co., New Orleans, La.

Unless you have used Standard Oil Lubricants throughout your plant, you'll never know the difference the *right kind* of lubrication can make. There is available to you in Standard Oil Lubricants the knowledge accumulated from more than sixty years of lubrication service to southern industry, backed by the largest combined facilities for testing and research of petroleum products in the world. ... If there is any question in your mind regarding the *proper* lubricant for any *specific* need, a Standard Oil lubrication engineer will survey your plant and blueprint your lubrication requirements. Why not take advantage of this experienced service today?

you'll never know

STANDARD OIL COMPANY INCORPORATED IN KENTUCKY



A Day in the Life OF A GRAVER Reactivator

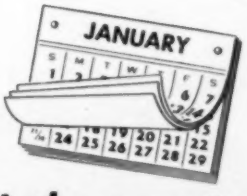
WATER CLARIFIER AND SOFTENER

The above graphs show the uniform results being obtained from a GRAVER Reactivator with widely varying flow at an installation treating a turbid surface supply.

Such results are typical of GRAVER Reactivators, for in installations throughout the country, these units maintain constantly higher clarity and quality of effluent through sudden or wide changes in flow rate and water consumption.

Highly efficient upflow clarification and softening is obtained due to the following exclusive design features . . . high rate sludge recirculation . . . upflow sludge filtration through a concentrated zone of accumulated precipitates . . . positive continuous sludge removal.

Write for catalog describing GRAVER Reactivators in detail, and ask for advice on your particular water problem. Specific recommendations from the long-experienced GRAVER engineers and chemists are offered without the slightest obligation.



It's the same story

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Maxiflow Safety Valves

The increasing unit size and operating requirements of high-pressure, high-temperature steam generating equipment *virtually dictated* the design and development of the Consolidated "Maxiflow" Safety Valve. These valves, *new in all that modern engineering can contribute,* have established new standards of safety and service. Tested and performance-proved both in the shop and in the field, the "Maxiflow" meets all demands of today's large steam generating installations.

Design and operating "Maxiflow" features include:

The Thermodisc Seat permits rapid equalization of temperature differentials. Thermal stresses are minimized, seat distortion is prevented, permanent tightness is achieved.

Mechanical Through Bushing with precision-machined surfaces that assure constant entrance conditions for steam flow. Leakage, due to porous castings, is eliminated.

Control of Blowdown adjustable to a new, low minimum. The exclusive "micrometer" trim ring provides a simple and chatter-proof blowdown control, externally controlled and operable with valve under pressure.

Popping Point Retention is gained by combining proper compensation with materials having low coefficients of expansion.

Complete capacity tables, *description and features of the Consolidated "Maxiflow" Safety Valve are contained in Bulletin 707. We will be glad to send you a copy.*

See your local distributor for complete information

CONSOLIDATED *SAFETY* VALVES

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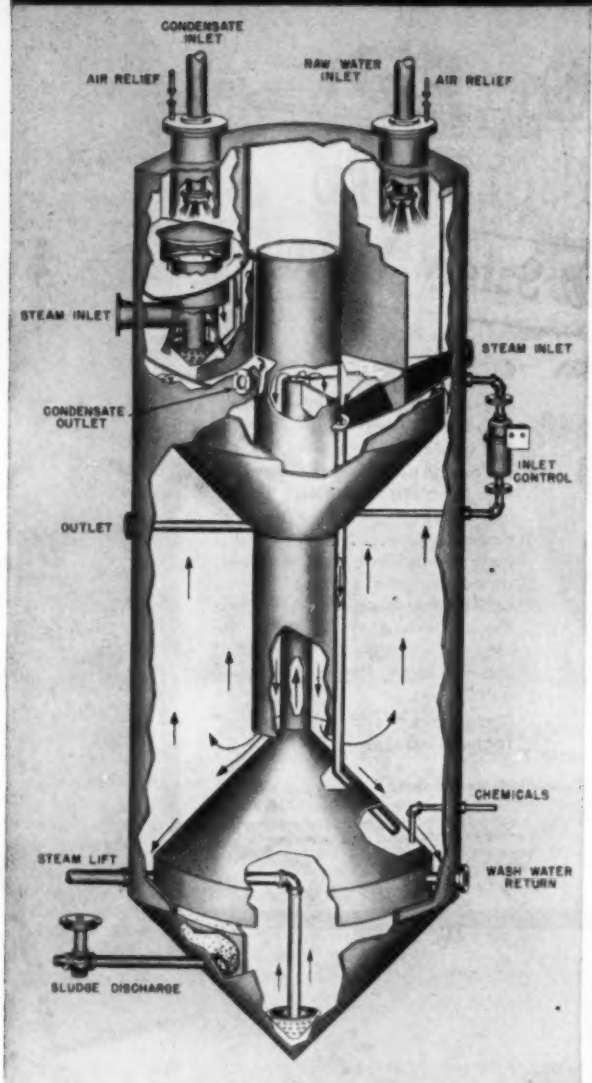

MULTI-PASS TREATMENT FOR

- *Softening*
- *Silica Reduction*
- *Deaeration of Makeup and Condensate*

HERE'S THE ANSWER TO 3 OF THE POWER ENGINEER'S MOST COMMON PROBLEMS

SOFTENING: Positive internal slurry recirculation insures maximum softening, alkalinity reduction, and turbidity removal with a minimum of chemical expenditure. A steam lift effects the recirculation thereby eliminating mechanical pumping devices. A storage compartment within the tank holds sufficient treated water to handle momentary peak demands.

SILICA REDUCTION: Prolonged contact of the water undergoing treatment with the recirculating slurry as well as the redissolving of magnesium in the slurry, reduce silica to a new low.

DEAERATION: The steam lift effectively deaerates the makeup water undergoing treatment, thereby eliminating the need for separate deaerating mechanisms. The condensate enters a separate chamber in the upper portion of the tank and is recycled and scrubbed by its own steam lift system.

Check these advantages of the Deaerating Hot Process Accelator: 1. Self-contained deaeration for both makeup and condensate, 2. Controlled slurry recirculation, 3. Maximum silica reduction by the redissolving of magnesium, 4. Reprecipitation for chemical economy, and 5. An effluent low in turbidity, alkalinity, and hardness. Investigate the new Deaerating Hot Process ACCELATOR. Write for complete information, now.

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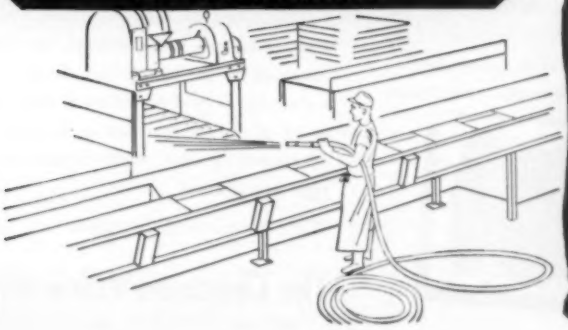
INDUSTRIAL RUBBER PRODUCTS BY

REPUBLIC RUBBER DIVISION

Lee Rubber & Tire Corporation

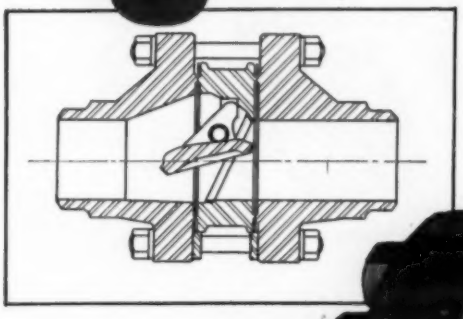
YOUNGSTOWN, OHIO



"Republic's New Hot Water Washdown Hose has a tough, grease-resistant cover that doesn't mark or discolor our stainless steel meat packing equipment. What's more the hose is lightweight, flexible easy to handle in every respect. We're sold on Republic!"

FOR HIGHER PRESSURES

3 Piece Tilting-Disc Check Valve



Has Removable Center Section for Quick and Easy Replacement of Operating Parts

Here's a Tilting-Disc Check Valve designed specifically for higher pressures. Its construction permits replacement of operating parts, if ever necessary, without removal of entire valve from the line. Once the studs between inlet and outlet sections of the body are taken out, the entire center section (containing disc, seating face and hinge pins) can be removed. Replacement of center section is fast, easy — an important advantage.

Important, too, is the smooth, easy operation obtained by the tilting-disc design. The balanced disc is held on the open stops by the velocity of the medium being handled. There's no slamming on closure to cause destructive pipe line stresses.

Write for complete description.

The Chapman Valve Mfg. Co.
INDIAN ORCHARD, MASSACHUSETTS

Timely Comments

Product Development

ENGINEERING DEVELOPMENTS have been the basis of solid accomplishment that are of inestimable value to industry generally. They suggest a healthy condition of engineering ingenuity and progress that augurs well for the industrial future of our country.

However, serious obstacles that impede the creation of basic new materials and products are discussed in the January issue of the WESTINGHOUSE ENGINEER by C. A. Scarlott. These obstacles mostly arise from restrictive regulations, uncertain patent protection, and a system of profit limitation that drains incentive from the large, more costly, but also more valuable programs for development of new materials and products.

The patent system has been one of the strengths of this country. Under it there has been assurance that, if risk were taken and success achieved, there would be opportunity for recovery of investment and for profit. A patent system is not just a set of rules but the legal interpretation of them. The trend of court decisions has been to lessen opportunity of reward for risk taken. There have, fortunately, been some hopeful signs in recent months that this trend may be halted.

Three Factors

As to a major development of, say, a new high-temperature alloy for jet engines or gas turbines, three things must be taken into account, according to Mr. Scarlott. Such a development is **costly**, perhaps a million dollars. It requires **time**, five years or more. Also, there is **no guarantee** that the venture will succeed; the chances are from five to ten to one that it won't. This requires that there must be good assurance of corresponding recovery of initial development investments on those ventures that do pan out. To bring a major development to commercial suitability requires the potentialities of more than normal profits.

A Tortuous Course

Where military contracts are involved, price redetermination, renegotiation, the Vinson-Trammell Act, and similar profit-limiting legislation may scale down the returns because of the difficulty of demonstrating the costs incurred in the effort. This is particularly important at a time like the present when the proportion of industry's business with the government is high. In addition, profits from all developments are subject to a high corporation income tax (42 per cent in 1950; higher in 1951).

The result is that for the future the possible rewards of development success are not great enough for the high order of risk taken. The profit-limitation philosophy to a large extent assumes that all ventures are successful. It does not take adequate account of the cost of the many more that fail.

Any tendencies toward weakening patent protection for successful ventures or disregarding the high initial costs of product development and the risks involved are dangerous things. They remove the incentive for pushing forward, which is one foundation of our industrial might.

♦

The Subcontracting System

SUBCONTRACTING is the business practice whereby the company contracting for an over-all job hires other companies to do certain parts of that job. The success of this practice depends as much upon the small subcontracting firm as upon the large prime contractor.

American industry must make effective use of subcontracting, according to Harry L. Erlicher, of General Electric, if the war effort is to approach maximum production.

During World War II, the teamwork and co-operation between subcontractors and prime contractors made possible the many production miracles that are history today, according to Mr. Erlicher.

The subcontracting system is an excellent means of spreading the benefits of large contracts on a broad geographical basis and in a minimum of time. This makes for minimum vulnerability in case of bombing attacks. With multiple sources of supply, production of important war material—such as jet engines, guided missiles, gunnery systems, radar—will not be knocked out completely by the potential destruction of one area.

Both large and small companies benefit from the subcontracting system. The large prime contractor needs the specialized techniques of the subcontractor in order to augment his own production program. On the other hand, the smaller firm can participate as a member of a team in major government programs, programs which he could not handle alone because of incomplete facilities.

Furthermore, the subcontractor in this way can avail himself of the engineering, manufacturing, and procurement experience of the prime contractor and can eventually develop himself into the position of a potential prime contractor.

New Southern Division For . . .

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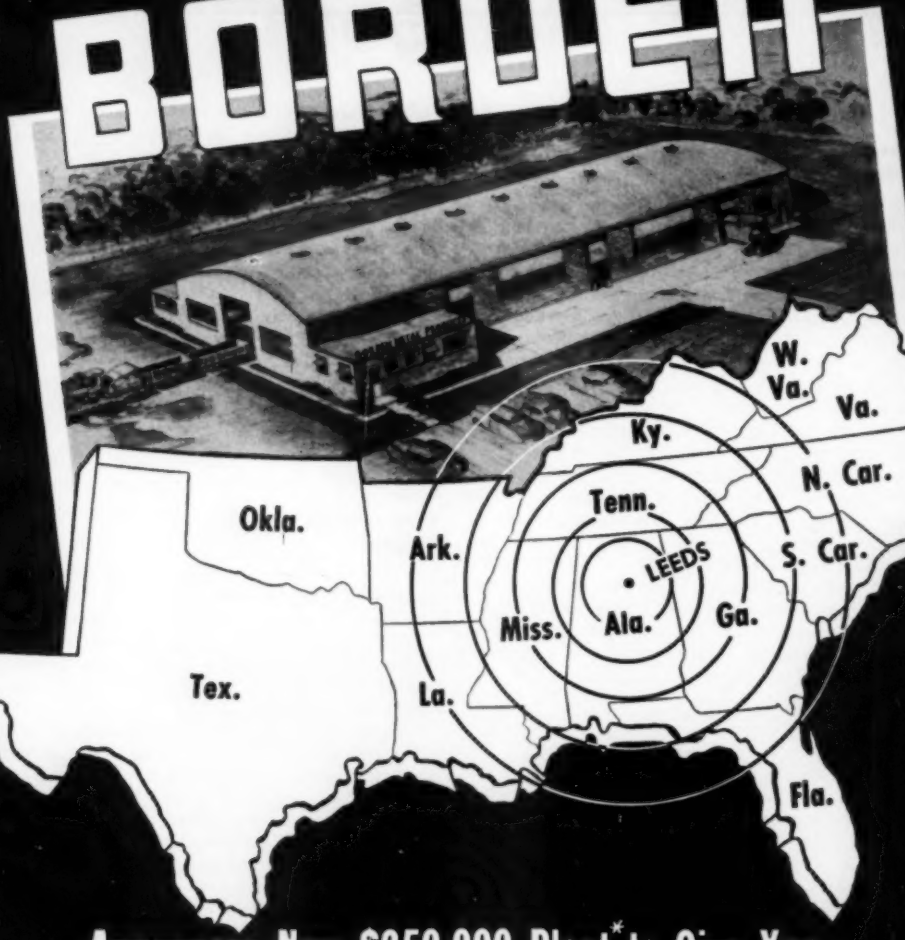

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Industry Speaks

Power and the National Emergency

By Louis V. Sutton

President, Carolina Power & Light Company
and
President, Edison Electric Institute

TAKING the 1950 shift to a partially mobilized economy in stride, the nation's electric light and power industry has demonstrated its ability to provide electricity for both defense and civilian needs, and at the same time has registered impressive gains in electric generating capability, power production, sales and customers.

A major gain recorded in 1950 was the installation of 6.7 million kilowatts of new generating capability. The electric companies' expansion program, begun at the close of World War II, continued in high gear; and the companies stepped up the tempo of capacity additions as well as placing large orders for equipment deliveries to maintain the existing high rate of generating capacity installation over three or four years ahead.

Power generation moved sharply up during the year, reaching a new high for the electric industry of 328 billion kilowatthours, nearly 12 per cent greater than the previous record output of 1949. The addition of 58 billion kilowatthours generated by industrial and railway plants for their own use brought electricity production by all sources in the U. S. to a total of 386 billion kilowatthours for 1950.

Current Emergency

The progress made in 1950 indicates the strength of the electric industry and gives firm backing to the conviction that in the current national emergency the industry can match its record of service to the country in World War II, when there was plenty of power for every need, whether military or civilian. The industry's kilowatthour generation in 1950 was twice that of 1941; kilowatts of reserve generating capability were about equal to the reserves at the time of Pearl Harbor; and important improvements have been made during and since World War II in operating efficiency, power pooling and interconnection of electric systems.

The business-managed electric companies, with 85 per cent of all electricity sales, have by far the greatest responsibility for electricity supply. Since the end of World War II, the companies have been engaged in a $15 billion expansion program, unequaled in the history of any industry, which is expected to add more than 31 million kilowatts of generating capability by the end of 1953. This expansion is now half completed, and the successful attainment of the projected 1953 goal is contingent on there being no interference with manufacturers' schedules.

Such interference could have serious effect on the power supply situation. Alteration of these schedules could not increase the amount of electric generating capability to be installed in the next two years. It would upset power supply plans carefully made by the utility systems to suit the needs of their areas.

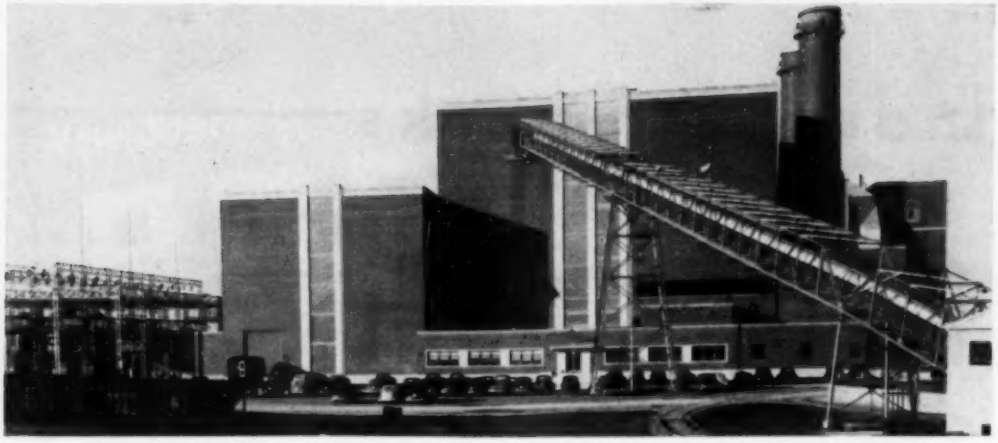
Also it must be emphasized that if equipment intended for the nation's electric systems should be diverted to other purposes, our predictions and expectations would, of course, be without the foundation which careful planning, ordering, and scheduling have provided.

Future Capacity

Assuming that construction is allowed to proceed as planned, the electric companies will have over 75 million kilowatts of generating capability at the end of 1953, more than twice the figure at the beginning of 1941. For the industry as a whole, the 1953 total will be 93½ million kilowatts.

Under the projected expansion, reserve margins of generating capability are expected to show successive increases, reaching 14½ per cent of the year's peak in 1951; 18 per cent in 1952; and 20 per cent in 1953. The calculations of load growth on which these reserve margins are based do not include large individual war production plans on which no definite information is available at this time. As such large individual requirements appear, there will probably be some drawing upon these reserves and, in addition, special provisions for installation of power facilities will be necessary.

It is of course important that the locations of any such heavy defense loads be established with due regard to available power reserves.



FRONT OF BUILDING WITH 69 KV SWITCHYARD ON LEFT AND COAL HANDLING EQUIPMENT IN FOREGROUND.

Potomac Electric Power Company's

New Potomac River Station

Independent 80,000 kw units operated at 850 pounds and 925 F, should give high load factor service with minimum maintenance.

THE new Potomac River Generating Station of the Potomac Electric Power Company is located in Alexandria, Virginia, on the westerly bank of the Potomac River almost opposite the City of Washington and within view of the Nation's Capitol. Planning for this new generating station dates back to 1942, when the site comprising 23 acres was purchased for the construction of a steam power plant to have an ultimate capacity of 400,000 kw in five 80,000 kw nameplate rated turbine-generator units. The first 80,000 kw unit was placed in commercial operation October 1949. The second unit which was a duplicate, was placed in commercial operation in June 1950.

Design Features

It was desired to develop the plant on the basis of conservatively designed and rated equipment suitable for reliable operation for long periods of time with a minimum of maintenance requirments. After careful consideration, it was decided to install initially two 80,000 kw nameplate rated turbine-generator units with throttle steam conditions of 850 psi gage, 925 F, with five points of steam extraction for feedwater heating.

The Company had experienced satisfactory operation with previous unit system installations consisting of one boiler for each turbine-generator and it was decided to continue with this type of installation at the new plant. A single boiler with a continuous rated capacity of 800,000 lb per hr was provided to furnish steam to each 80,000 kw turbine-generator. No cross-connections were provided between the two boilers or turbines.

Particular attention was given to building volume and equipment layout to provide ample space and easy accessibility to equipment for operation and maintenance. And since the location was in a residential area, it was essential that every precaution be taken to prevent smoke or dust nuisance.

Because of the location of the plant with respect to the Washington National Airport, a compromise had to be effected between conflicting requirements of stack height, therefore height of the stacks was reduced 89 ft below that originally planned. The height of the radial brick stacks was limited to a distance above the boiler room roof of about one third the height of the boiler room. It was felt that this was the minimum stack height which would give assurance of proper and safe dispersion of gases and any remaining solids. At the same time increased velocity of gases leaving the stack was provided for by means of a venturi throat or nozzle built within the stack. At full boiler load the velocity of the gases leaving the stacks is approximately 60 miles per hour.

Another consideration was the desirability of harmonizing the external appearance of the station with the general architectural pat-

tern of the area and particularly with that of near-by apartment houses. This was accomplished by the use of red exterior face brick trimmed with gray limestone. The use of glass block windows added materially to the appearance of the building.

Generating Equipment

The turbine-generators are General Electric, single-cylinder, 1800 rpm, 80,000 kw nameplate-rated machines with throttle steam conditions of 850 psi gage, 925 F, steam being extracted at 3rd, 6th, 9th, 12th and 14th stages for feedwater heating. Of the five extraction feedwater heaters, the 14th is a low-pressure closed heater with separate drain cooler, the 12th is a direct-contact heater, the 9th is a low-pressure closed heater, the 6th is a standard tray-type deaerating heater with boiler-feed suction tank, and the 3rd is a high-pressure closed heater.

The generator is hydrogen cooled and has a nameplate rating of 80,000 kw at 0.85 power factor and 0.5 psi gage hydrogen pressure. It is designed for 13,800 volt, 3 phase, 60 cycle service with direct-connected main and pilot exciters. One motor-generator set is provided for emergency excitation of either unit.

Each turbine exhausts into a 75,000 sq ft, two-pass condenser, containing 12,720 Admiralty metal tubes, No. 18 B.W.G. 26 ft long and 7/8 in. O. D., through which cooling water is pumped at the rate of 66,900 gpm.

Condenser air evacuation is performed by two motor-driven, rotary dry vacuum pumps for each unit. Each pump has a capacity of 540 cfm of air-vapor mixture at one in. Hg abs pressure.

Condensing water from the river is supplied by two vertical circulating water pumps per condenser, each pump having a rating of 33,450 gpm at a total head of 49ft. Because of subsoil limitations and the gradient between river bank and the plant, the circulating water pumps were located in a pump house on the river bank and the circulating water pumped through steel pipes to the condensers in the turbine room basement. Inside the station this piping is largely run overhead in order to eliminate foundation difficulties due to subsoil conditions.

Three boiler feed pumps, each driven by an 800 hp, 2300 volt, 3600 rpm squirrel cage induction motor, are provided for each turbine generator unit, any two of the pumps being capable of meeting full load boiler feedwater requirements. No steam-driven boiler feed pumps are provided.

The only steam-driven auxiliaries in the plant are the auxiliary lubricating oil pumps on the main turbines.

The steam generating units are the Combustion Engineering three-drum, bent-tube type with water-cooled furnace, pendant-type superheater, economizer, tubular air preheater, vertically adjustable tangential burners and Combustion Engineering Raymond bowl mills. The furnace is designed for initial operation with pulverized coal, and provision has also been made for possible future use of fuel oil or natural gas. The unit is arranged to burn a wide range of West Virginia and Pennsylvania coals, as follows.

Btu as fired	12500 - 14500
Ash fusion Temp.	2100-2800 F
Ash content, %	4.5-12
Sulfur, %	0.5-3.5
Fixed Carbon, %	53-80
Grindability	60-100

Design pressure for the boilers is 1000 psi gage with operating steam conditions at the superheater outlet of 875 psi gage, 925 F. As indicated in the accompanying cross-section, the furnace has a dry hopper bottom with shaded ashpit. This design of furnace bottom has resulted in a substantially

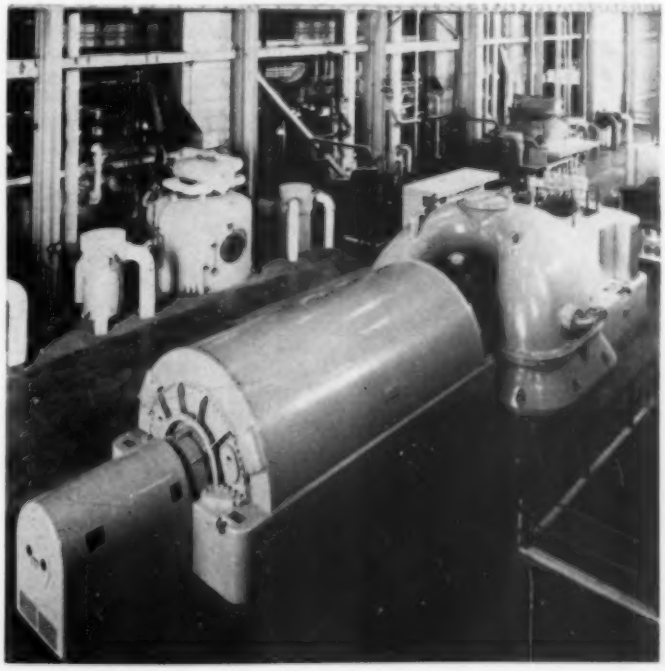
By L. W. Cadwallader

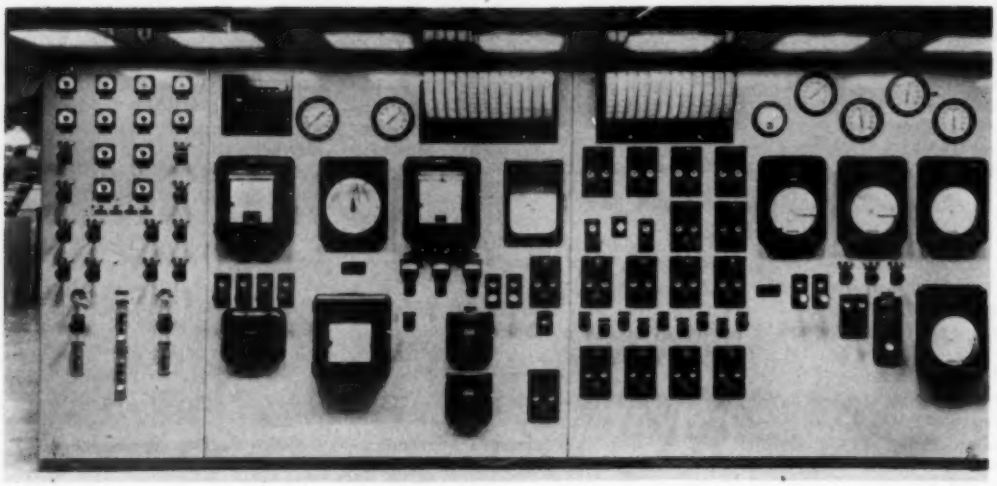
General Superintendent of Generating Stations

Potomac Electric Power Company

Washington, D. C.

TURBINE ROOM AT PEPCO'S NEW $25,000,000 POTOMAC RIVER POWER PLANT. THE 80,000 KILOWATT TURBO-GENERATORS AT THIS PLANT ARE THE LARGEST ON THE PEPCO SYSTEM.





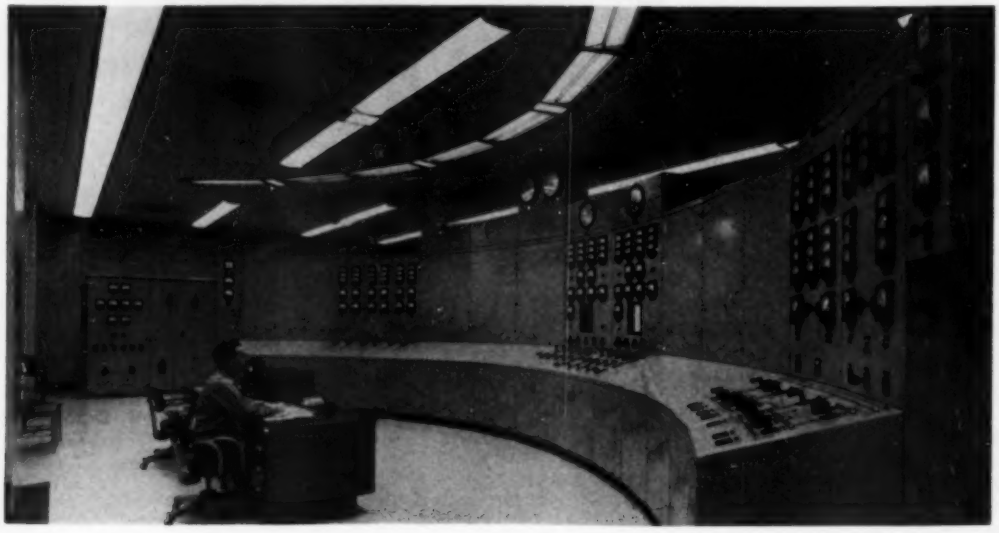
BOILER INSTRUMENT AND CONTROL PANEL.

cooler ashpit than the conventional symmetrical design, and is believed to be the first installation of this type. It is of particular importance in this installation because the furnace bottom ash is removed in a completely dry state by gravity discharge through manually operated gates into a vacuum transport system. It requires the time of one operator for a period of approximately 20 minutes once every 8 hours to remove the dry furnace bottom ash with this vacuum transport system. This is the same system which empties automatically all of the 33 fly-ash hoppers of each boiler unit.

Specifications call for a total steam temperature at superheater outlet of 925 F from 425,000 lb of steam per hour up to the maxium evaporation rate of 800,000 lb per hr. Operating experience indicates that 925 F can be maintained over a wider load range than was specified. While the design provided for primary steam temperature control by means of tilting burners supplemented by bypass dampers, in operating service under normal conditions the superheater bypass dampers remain closed.

The boiler is provided with four bowl mills with sufficient capacity so that any three will carry full boiler load with good quality coal and four will carry full boiler load with the worst coal specified. There are four levels of coal burners or a total of 16 burners. The secondary air dampers for each level of coal burners are remotely positioned from 5-point selector switches mounted on the boiler gage board

CENTRAL SWITCHBOARD ROOM. BLANK PANELS ARE FOR 3 FUTURE UNITS.



and actuating motor drives mounted on burner windboxes. This arrangement of damper control is an innovation and has been quite satisfactory.

The steam generating unit has a maximum continuous rating of 800,000 lb per hr with superheater outlet conditions of 875 psi gage and 925 F, and feedwater temperature of 420 F entering the economizer. Predicted boiler performance when burning coal and operating under above conditions is 88.9 percent. The furnace heat release at 800,000 lb per hr output is 16,900 Btu per cu ft per hr and the net heat available for the entire project radiant surface is 102,000 Btu per sq ft per hr.

Each boiler is equipped with a complete steam soot blowing system for furnace walls, superheater, economizer and tubular air heater. After some experimentation the following schedule of soot blowing was established.

Furnace walls

As needed to remove spotty ash accumulations. A portion of the 12 wall blowers are operated on an average of once every 24 hrs.

Superheater and economizer

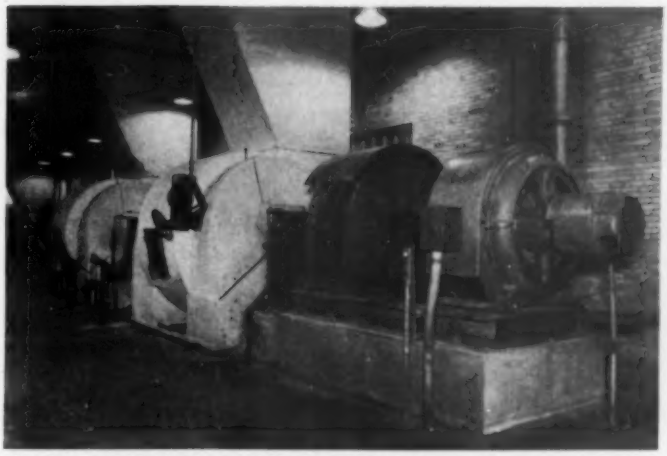
Once every 2 weeks.

Tubular air heater

No soot blowing.

FLY-ASH CONTROL

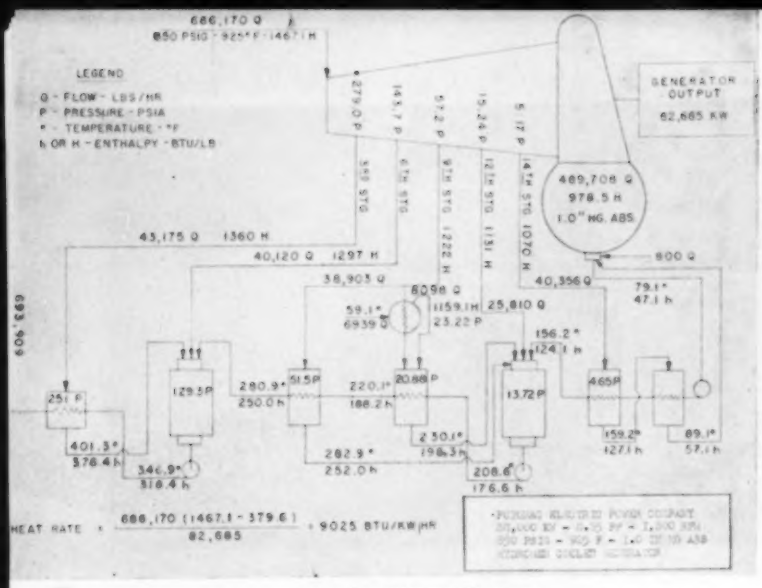
Every effort was made in the design of this station to eliminate any possible nuisance due to dust and stack emission. It was expected that coal would be the primary fuel and to date only coal has been burned. To reduce stack emission to a minimum, it was decided to install in series both a mechanical fly-ash collector and an electrostatic precipitator three sections deep. These are located between the air heater and the stack, the flue gases passing through the mechanical collector first. The air heater, mechanical collector and electrostatic precipitator are divided into four sections across the width of the steam generating unit, with dampers at the inlet to each section so arranged that one fourth of the precipitator at a time can be rapped in still gas. Performance



INDUCED DRAFT FAN. SHOWING 700 HP, 2300 VOLT SQUIRREL CAGE INDUCTION MOTOR WITH DIRECT CONNECTED EXCITER FOR VARIABLE SPEED MAGNETIC COUPLING.

800 HP BOILER FEED PUMPS IN CENTER BACKGROUND—3 PUMPS PER BOILER.

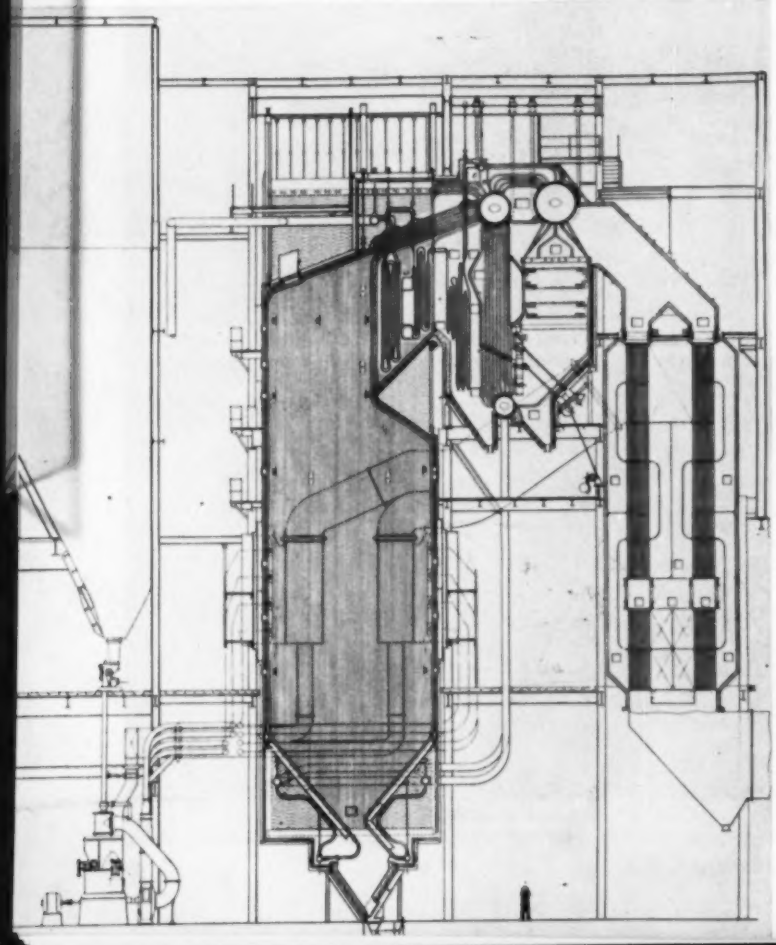
RAYMOND BOWL MILLS—4 PER BOILER.


LEGEND
Q - FLOW - LBS/HR
P - PRESSURE - PSIA
° - TEMPERATURE - °F
h OR H - ENTHALPY - BTU/LB
GENERATOR OUTPUT
62,665 KW
HEAT RATE = 686,170 (1467.1 - 379.6) / 82,685 = 9025 BTU/KW/HR

HEAT BALANCE DIAGRAM

has been gratifying as there is little visible discharge from the stacks. Soot blowing and cleaning of electrostatic precipitator plates have had little or no effect on stack appearance.

COMBUSTION ENGINEERING CO. STEAM GENERATING UNIT.



COAL HANDLING

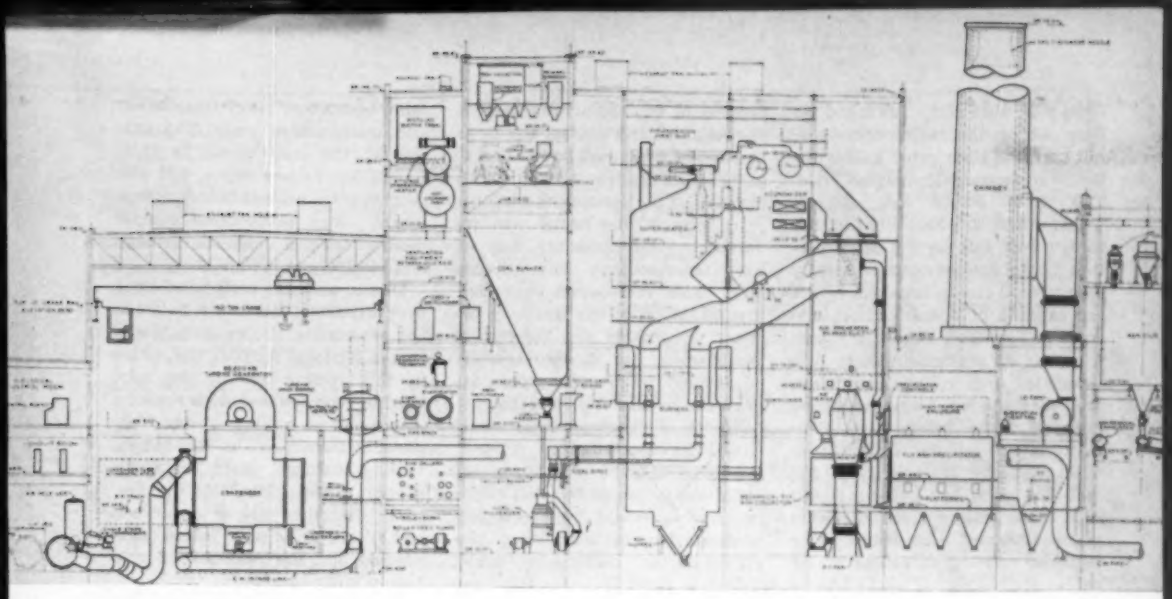
Bituminous coal from Pennsylvania or West Virginia is delivered in railroad cars to the plant yard which has a capacity of approximately 100 coal cars. The cars are weighed on an accurate track scale and then unloaded by a rotary car dumper. With the layout provided, it is possible to weigh, dump and shift one railroad car of coal every six minutes. All shifting in the plant yard is performed by a 50-ton fireless locomotive which is charged once every four hours from the main boilers in the power house. The fireless locomotive has the advantage of cleanliness and low operating and maintenance costs.

Coal from the car dumper pit can be delivered by conveyor belts at the rate of 700 tons per hr to Bradford coal breaker. From this point the coal can be delivered at the rate of 350 tons per hr to both the storage area and to the station bunkers.

When the generating capacity of the plant is increased by the installation of additional units, it is contemplated that the rate of handling coal to the bunkers will be increased to 700 tons per hr by the addition of a duplicate belt conveyor between the Bradford coal breaker and the bunkers.

The coal storage area has a capacity of approximately 175,000 tons when stored to a height of 30 ft. All storing and reclaiming of coal is done with bulldozers. There is one coal bunker per boiler, each bunker having a capacity of 1200 tons. From the bunkers the coal flows through motor-driven coal feeders located on the main operating floor. These feeders regulate the flow of coal to the bowl mills.

The rotary railroad car dumper is totally enclosed, a rolling steel door being installed at either end to permit the shifting of full cars onto the dumper and the removal of cars after they have been unloaded. Elaborate systems of dust collecting equipment have been provided for the rotary-car dumper house, Bradford breaker house, coal bunkers in the station, and all intermediate belt conveyor junc-



PLANT CROSS-SECTION SHOWING ARRANGEMENT OF EQUIPMENT.

tion points where dust could result from coal transfer. The fine dust thereby collected is conveyed to the coal bunkers by a vacuum system which removes the dust from the collectors and discharges it into either coal bunker.

To wet the coal as it is placed in storage, a chemical spraying system is provided. It is also planned to spray the surface of the storage pile with heavy fuel oil to prevent dusting.

ELECTRICAL FEATURES

Each of the 80,000 kw, 85 per cent power-factor generators are directly connected to two 60,000 kva transformers, to step up the energy from 13,800 to 69,000 volts for transmission to the load. Engineering studies showed this to be more economical than tying the generators together at low voltage, and stepping up through transformers tied directly to the 69,000 volt cables. The 13,800 volt generator leads to the transformer terminals are made of the isolated phase construction. These consist of three 20½ in. diameter outer aluminum enclosed, dust and vapor-proofed pipes. Inside of each pipe a 6 in. copper tube is used as a conductor which is securely braced at each 90 degree angle and supported and insulated by porcelain insulators at five to eight feet intervals to withstand the shock of short circuit.

Main step-up transformers are

OPERATING DATA COVERING NO. 1 UNIT FROM OCT. 16-'49 TO JULY 31-'50 AND UNIT NO. 2 FROM JUNE 12 TO JULY 31-'50.

No.	Description and Source		# 1 Unit	# 2 Unit
1	Total Gross K.W.H. Gen.	(Switchboard)	427,851,000	76,788,000
2	Total K.W.H. Sta. Uses	(Switchboard)	24,976,000	4,163,000
3	Total Net K.W.H. Output.	(1) — (2)	402,875,000	72,625,000
4	Station Service % of Gr.	(2) × 100 ÷ (1)	5.84	5.42
5	Water Fed to Boilers.	(Metered)	3,549,092,000	643,905,000
6	Steam Leaving Boilers.	(Calculated)	3,545,770,000	643,710,000
7	Steam to Turbines.	(Calculated)	3,543,771,000	643,385,000
8	Temp. of Steam	(Av. Weighted Obs.)	921	920
9	Press. of Steam.	(Av. Weighted Obs.)	875	875
10	Temp. of F.W.	(Av. Weighted Obs.)	389	389
11	Net B.T.U. per lb. of Steam.	(Tables)	1,101	1,100
12	Banking Coal.	(Calculated)	–	–
13	Steaming Coal.	(Calculated)	314,366,000	55,628,000
14	Total Coal Burned.	(Scales)	314,366,000	55,628,000
15	B.T.U. per lb. of Coal as Fired.	(Analysis)	13,973	14,229
16	Condenser Back Press.	(Av. Wtd. Obs.)	.95	1.70
17	Circulating Water Temp.	(Av. Wtd. Obs.)	53	80
18	Hours Operation.	(Switchboard)	6,124.5	1,075.2
19	Average Load.	(1) ÷ Rating × (18)	87.3	89.3
20	Capacity Fact.	(1) ÷ Rating × Hrs. Mo.	77.4	80.4
21	Station Water Rate.	(5) ÷ (1)	8.30	8.39
22	Turbine Water Rate.	(7) ÷ (1)	8.28	8.38
23	Act. Turb. B.T.U./Gr. K.W.H.	(22) × (11)	9,116	9,218
24	Stand. Turb. B.T.U./Gr. K.W.H.	(B.P.)	9,020	9,300
25	Stand. Turb. B.T.U./Gr. K.W.H.	(C.W.)	8,990	9,320
26	Boiler Steaming Efficiency	(Calculated)	88.8	89.2
27	Net Boiler Room Efficiency	(Calculated)	88.6	89.1
28	Boiler Standard Efficiency	(Calculated)	89.2	89.4
29	Average Boiler Output	(3) ÷ (31)	579,500	598,900
30	Boiler Use Factor	(31) ÷ Hrs. Mo.	88.6	96.2
31	Hours Steaming	(Boiler Log)	6,124.7	1,075.2
32	Hours on Bank	(Boiler Log)	142.3	45.1
33	Hours on Repair	(Boiler Log)	668.0	73.7
			Operating / Over All	Operating / Over All
34	Lbs. of Coal/K.W.H. Net*	(Calculated)	.782 / .783	.767 / .768
35	B.T.U./K.W.H. Gross	(Calculated)	10,283 / 10,296	10,340 / 10,353
36	B.T.U./K.W.H. Net	(Calculated)	10,920 / 10,934	10,933 / 10,946
37	Thermal Efficiency	3413 ÷ (36)	31.25 / 31.21	31.22 / 31.18

equipped with fans arranged to blow air on the radiators to permit carrying their rated load without excessive temperature rise. The main 60,000 kva step-up transformers are connected on the 69,000 volt side to the main station buses through pneumatically operated oil circuit-breakers which are capable of opening short circuits of 2,500,000 kva. The transformers, oil circuit-breakers and associated high voltage equipment are located in a switch yard adjacent to the turbine room. Ultimate layout of the station provides for five sections of 69,000 volt bus, each fed by two 60,000 kva transformers from different generators, and each feeding two to three 45,000 kva cables. These cables are connected to the bus by oil circuit-breakers similar to those connecting the transformers.

In case of a short circuit, the proper breakers to disconnect the faulty equipment are opened automatically by relays. Normally, the bus sections will be tied together only through the generator transformers, although they can be tied directly together by means of oil circuit-breakers when a generator is shut down for any reason. The purpose of this bus arrangement is to "cushion" and control the large amount of generated power and to prevent excessive short circuit currents at the generating station.

In spite of the heavy cost involved, it was necessary that all lines transmitting the energy away from the station be underground. Much of the territory between the station and the city of Washington has been carefully landscaped to provide scenic approaches to the city, and the appearance of overhead lines would have been objectionable.

Studies showed that three 600 MCM-conductor, 69,000 volt cables in conduit would be more economical than higher-voltage, single-conductor cables, or cables pulled in pipe. This was the highest voltage three conductor cable available and two such cables furnish sufficient capacity to load one 80,000 kw generator. Conductors and insulation are enclosed in a lead sheath and a nitrogen gas pressure of 35 to 45 lb is maintained inside the cable. This is believed to be the first installation of gas-filled 69,000 volt cable. This so-called "gas-filled" cable was preferred to "oil-filled" cable because of lower installation and maintenance costs. The outside of the lead sheath is reinforced by bronze tapes and the whole cable enclosed in a neoprene jacket for protection against mechanical and chemical damage and electrolysis.

Due to unstable earth conditions over a part of the route between the generating station and Washington National Airport, the cables in this section are of the submarine type covered with metallic armor and no conduit is used. This permits movement of the cables, without damage, when the earth support moves. Many of the features described above are novel but all are based upon sound engineering and the lines should give high-quality service.

Based on a nameplate generator rating of 160,000 kw and including cost of site and everything constructed on it except outgoing feeders and the external distribution system, the cost of the Potomac River Generating Station will approximate $155 per kw. Details on performance and efficiency are given in the accompanying summarized operating report.

Principal Equipment

Generating Station "C", Potomac River, Potomac Electric Power Company

GENERAL DATA

Name of Station ..... Potomac River Generating Station.
Station Site ..... Alexandria, Virginia
Steam Conditions ..... 875 psig, 925 F
Cooling Water Source .... Potomac River
Design and Construction .. Stone & Webster Engineering Corporation.

TURBINE-GENERATORS

Turbines ..... Two—General Electric Company, 80,000 kw, 850 psig, 925 F, 1 in. Hg abs, 5 bleed points, 1800 rpm.
Generators ..... Two—General Electric Company, 1800 rpm, hydrogen cooled, 80,000 kw at 0.5 psig hydrogen pressure, 13,800 volts, 3 phase, 60 cycle, 0.85 pf, 94,117 kva, and direct connected main and pilot exciters.
Main Exciters ..... Two—General Electric Company air cooled, 300 kw, 1800 rpm, 250 volts.
Pilot Exciters ..... Two—General Electric Company air cooled, 4 kw, 250 volts, 1800 rpm.

CONDENSING EQUIPMENT

Surface Condensers ..... Two—Worthington Pump and Machinery Corp. 75,000 sq ft, 2-pass, inner air coolers and hotwell.
Circulating Water Pumps.. Two per condenser—Worthington Pump and Machinery Corp. vertical, 33,450 gpm, 49 ft total head.
Circulating Pump Drives .. Allis Chalmers Manufacturing Company 600 hp, 590 rpm, 2300 volts, 60 cycle.
Rotary Vacuum Pumps .... Two per condenser—Kinney Manufacturing Company 540 cfm at 1 in. Hg abs, approximately 29 lb per hr water vapor and 16 lb per hr air at 70 F.
Vacuum Pump Drives ..... General Electric Company 40 hp, 350 rpm, 440 volts, 3 phase, 60 cycle.
Circulating Water Valves.. Henry Pratt Company, Inc.
Chlorinating Equipment ... Wallace & Tiernan Products, Inc.
Air Removal Pumps ..... Three—Nash Engineering Company.

STEAM GENERATING EQUIPMENT

Boilers ..... Two—Combustion Engineering-Superheater, Inc. 800,000 lb per hr continuous, 875 psig, 925 F, 36,020 sq ft, three drum, bent tube.
Superheaters ..... Two—Combustion Engineering-Superheater, Inc. 3 stages, low-temp 12,300 sq ft, int-temp 12,300 sq ft, high-temp 4,700 sq ft, bypass control and tilting burners, temperature control range 450,000 to 600,000 lb per hr.
Furnaces ..... Two—Combustion Engineering-Superheater, Inc. completely water cooled, shielded type hopper bottom.
Economizers ..... Two—Combustion Engineering-Superheater, Inc. continuous finned tubed, integral set, split type, 17,650 sq ft.
Pulverizers ..... Four per boiler—Combustion Engineering-Superheater, Inc. Raymond No. 533 bowl mill, 28,400 lb per hr, integral exhauster, variable speed roll type feeder.
Air Preheaters ..... Two—Combustion Engineering-Superheater, Inc. tubular, 4-pass, 122,500 sq ft.
Mechanical Fly Ash Collector One per unit—Aerotec Company multi unit centrifugal fly ash collector, maximum flow 325,000 cfm at 330 F, 85% removal (by weight) of suspended matter.
Electrostatic Precipitators.. One per unit—Research Corporation Cottrell perforated plate type, four units of 15 ducts each, three sections long; normal flow 294,000 cfm at 320 F, efficiency 96%.
Soot Blowers ..... Diamond Power Specialty Corporation.

No. per Boiler:

Furnace Wall	12 Type IS
Economizer	8 Type G9B
Air Heater	8 Type H
Superheater	4 Type IK
Screen Tubes	4 Type IK
Circulating Tubes	4 Type G9B

Combustion Control	Hagan Corporation.
Feedwater Flow and Level	Bailey Meter Company.
Superheat Control	Leeds & Northrup Company.
Blowoff Tank	Missouri Boiler & Sheet Iron Works.
Water Treating Equipment	Infilco Inc.
Safety Valves	Consolidated Div. Manning, Maxwell & Moore
Feed and Check Valves	Edward Valves, Inc.
Blowoff Valves	Yarnall-Waring Company
Water Columns and Gages	Diamond Power Specialty Corp.
Miscellaneous Valves	Hancock Div. Manning, Maxwell & Moore

DRAFT EQUIPMENT

Forced Draft Fans	Two per boiler—American Blower Corporation 110,000 cfm, 100 F, 11-in. total head, 1200 rpm, constant speed, inlet-vane control, louvre type damper in fan outlet.
Induced Draft Fans	Two per boiler—American Blower Corporation 190,000 cfm, 330 F, 15-in. suction, 720 rpm, variable speed, magnetic coupling control.
Induced Draft Fan Magnetic Coupling	Electric Machinery Manufacturing Co.
Forced Draft Fan Drive	Allis Chalmers Manufacturing Company 250 hp, 1170 rpm, 2300 volts, 3 phase, 60 cycle.
Induced Draft Fan Drive	Allis Chalmers Manufacturing Company 700 hp, 900 rpm, 2300 volts, 60 cycle, 3-phase.

FEEDWATER SYSTEM

Condensate Booster Pumps	Ingersoll-Rand Company, 2 per unit, 525 ft head, 1700 gpm, 1750 rpm.
Booster Pump Drives	Westinghouse Electric Corporation 300 hp, 2300 volts, 3-phase, 60 cycle, 1800 rpm.
Closed Heater 3rd Stage	One per unit—Westinghouse Electric Corporation 3,170 sq ft, quadrant type head, vertical, with U-tube removable bundle. Flow from heater 810,000 lb per hr at 420 F.
Closed Heater, 9th Stage	One per unit—Westinghouse Electric Corporation 3,000 sq ft, vertical with U-tube removable bundle. Flow from heater 710,000 lb per hr at 291.8 F.
Closed Heater, 14th Stage	One per unit—Westinghouse Electric Corporation 2-310 sq ft vertical with U-tube removable bundle. Flow from heater 615,000 lb per hr at 169.3 F.
Drain Cooler, 14th Stage	One per unit—Westinghouse Electric Corporation 320 sq ft, vertical with U-tube removable bundle. Flow from drain cooler 615,000 lb per hr at 104.4 F.
Evaporators	One per unit—Westinghouse Electric Corporation 880 sq ft, horisontal, submerged bundle, thermal descaling. Steam flow from evaporator 16,000 lb per hr.
Evaporator Deserating Preheater	One per unit—Worthington Pump and Machinery Corp. Capacity 18,110 lb per hr.
Evaporator Condenser	One per unit—Westinghouse Electric Corporation 1,060 sq ft horizontal U-tube removable bundle.
12th Stage Nondeserating Heater	One per unit—Worthington Pump and Machinery Corp. vertical, single shell, tray, 710,000 lb per hr, temp from heater 215 F, 16 psia steam pressure.
6th Stage Deserating Heater	One per unit—Worthington Pump and Machinery Corp. horisontal, two shell, storage, tray deserator; 810,000 lb per hr, 152 psia steam pressure, temp from deserator 359 F, 2 vent condensers, 16,275 gal storage tank.
Boiler Feed Pumps	Three per unit—Worthington Pump and Machinery Corp. balanced, 6 stage, volute, centrifugal, 1075 gpm at 360 F, 2480 ft total head, 3570 rpm, constant speed.
Boiler Feed Pump Drives	General Electric Company 800 hp, 3600 rpm, 2300 volts, 60 cycle, squirrel cage.
Extraction Nonreturn Valves	Atwood and Morrill Company

COAL AND ASH HANDLING EQUIPMENT

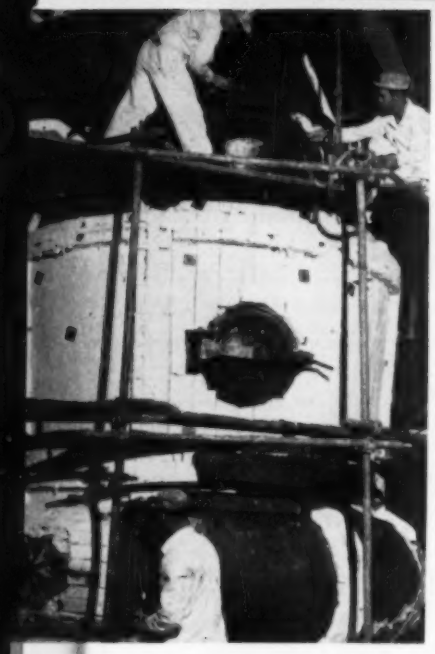
Railroad Track Scale	The Howe Scale Comapny
Rotary Railroad Car Dumper	Link Belt Company, capacity 700 tons per hour.
Coal Bunker Duplex Gates	Stephens-Adamson Manufacturing Co.
Bradford Breaker	Pennsylvania Crusher Company, capacity 700 tons per hour, 1-¾" openings.
Automatic Coal Scale	Stock Engineering Company
Vacuum-cleaning Equipment	Billmyre Div., Lamson Corporation.
Dust Collecting Equipment	Pangborn Corporation
Windswept Dust Valves	The Allen-Sherman-Hoff Company, hand operated
Ash Handling Equipment	The Allen-Sherman-Hoff Company.
Coal Spraying Equipment	Johnson-March Corporation
Belt Conveyor Tripper	Robins Conveyors Division
Coal Handling Equipment	Stephens-Adamson Manufacturing Co.
Tractors	Three—Oliver Tractor Company, equipped with Heil bulldozers.

MISCELLANEOUS EQUIPMENT

Gage Boards	Hagan Corporation.
Station Piping	Benjamin F. Shaw Company.
Circulating-water Piping	New York Central Iron Works.
Motor-operated Main Steam Valves	Chapman Valve & Manufacturing Company.
1500-lb Weld Valves	Manning, Maxwell & Moore.
Globe Valves	Manning, Maxwell & Moore.
Electric Traveling Crane	Whiting Corporation, 150 tons.
Automatic Air Filters	American Air Filter Corporation.
Ventilating Fans	Westinghouse Electric Corporation.
Elevators	Otis Elevator Company.
Sewage Ejector Pumps	Chicago Pump & Machine Company.
Tanks	J. E. Hurley Machine & Boiler Works.
Boiler Room Air Supply Fans	Sturtevant Div., Westinghouse Electric Corp.
Service Water Pumps	Two per unit—Ingersoll-Rand Company, vertical, 2 stage, 3250 gpm, 1175 rpm, 134 TDH.
Service Water Pump Drives	U. S. Electrical Motors, Inc., 150 hp, 1200 rpm, vertical hollow shaft, 60 cycle, 2300 volts, 3-phase.
Fire Pumps	Two—DeLaval Steam Turbine Company, horisontal, centrifugal, 1000 gpm, 139 TDH, 1750 rpm.
Fire Pump Drives	General Electric Company 50 hp, 440 volt, 60 amp, 1764 rpm, drip proof, squirrel cage.
Traveling Water Screens	Four—The Link Belt Company.
Hydrostatic Test Pump	Worthington Pump and Machinery Corp.
Miscellaneous Pumps	Yeomans Brothers.
Air Compressors	Two—Ingersoll-Rand Company. One—single stage, 300 cfm, 100 psi discharge. One—two stage, 900 cfm, 100 psi discharge.
Floor Grating	Hendrick Manufacturing Company.
Structural Steel and Bunkers	Bethlehem Steel Company.
Galvanized Substation Steel	American Bridge Company.
Channel-type Roof Slab	Lastek Products Company.
Stair Treads and Platform Plates	American Abrasive Metals Company.
Miscellaneous Iron	Empire City Iron Works.
Railings	A. F. Jorss Iron Works.
Corrugated Asbestos	The Ruberoid Company.
Steel Sash	The William Bayley Company.

ELECTRICAL EQUIPMENT

Main Transformers	
Unit No. 1	Two — Westinghouse Electric Corporation 3-phase, 48,000/60,000 kva, voltages 69,000 wye/13,800 delta.
Unit No. 2	Two—Allis Chalmers Manufacturing Company 3-phase, 48,000/60,000 kva, voltages 69,000 wye/13,800 delta.
Station Service Transformers	
Units 1 and 2	Two—Allis Chalmers Manufacturing Company 3-phase, 6,000/7,500 kva voltage 13,800/2,300 delta connected to generator leads.
.....	One—Allis-Chalmers Manufacturing Company 3-phase, 6,000/7,500 kva, voltage 69,000 wye/13,800 delta.
.....	One — Westinghouse Electric Corporation 3-phase, 6,000/7,500 kva, voltage 69,000 wye/13,800 delta.
.....	Three—Moloney Company 3-phase 750 kva, indoor, dry type voltage 2,300/460.
69 kv Oil Circuit Breakers	Fourteen — General Electric Company, 2,500,000 kva interrupting capacity.
13 kv Oil Circuit Breakers	Two—General Electric Company, 1,500,000 kva interrupting capacity.
Insulators	Locke Company; Ohio Brass Company.
Power and Control Cables	Okonite Company; Simplex Wire & Cable Company.
Distribution Cables	Okonite Co.; Habershaw Cable & Wire Co.; and General Electric Company, 69000 volts, gas-filled.
2300 Volts Switchgear	I-T-E Circuit Breaker Company, Multimite indoor with 64 air circuit breakers, 100,000 kva interrupting capacity.
440 Volts Switchgear	Westinghouse Electric Corporation. Low voltage, metal enclosed with 26 drawout air circuit breaker, type DK-25, 600 volts, 25,000 R.M.S. amps.
120/240 Volts Switchgear	Westinghouse Electric Corporation; Kalek Company.
Coalyard Unit Substation	Allis Chalmers Manufacturing Company.
Electric Indicating Instruments	General Electric Company
Relays	Westinghouse Electric Corporation.
Generator Voltage Regulation	General Electric Company, Type GFA-4.
Fire Protective Equipment for Main Transformers	Grinnell Company, Inc. Automatic, pneumatic, rate-of-rise actuated Multifyre (water spray) system.



VACUUM PAN INSULATED WITH 3-IN. THICK BLOCKS OF 85% MAGNESIA. FIRST, ROUGH COAT OF 85% MAGNESIA CEMENT IS BEING APPLIED OVER THE BLOCKS. NOTE THE BOLTS AND WASHERS USED TO ANCHOR THE INSULATION.

BOILER FEED PIPING AND VALVES AT LEFT ARE INSULATED WITH 85% MAGNESIA AND HIGH PRESSURE STEAM PIPING AT THE RIGHT IS INSULATED WITH COMBINATION DIATOMACEOUS SILICA-85% MAGNESIA INSULATION. INSULATION IS FINISHED WITH A CANVAS JACKET.

Heat Insulation at

By R. G. Ganong

Engineer, The Morton Salt Company

STEAM handling economy and efficiency and process temperature control are dependent, to a great extent, upon adequate thermal insulation. This is particularly true in a salt processing plant, where extensive piping systems are used to supply steam to turbogenerators for power production, and to grainers, evaporators and other processing equipment for grades of salt from brine.

Therefore, insulation design for our newly expanded salt processing facilities at Grand Saline, Texas, was integrated with the overall plant and process engineering. The processing facilities were designed and constructed by the H. K. Ferguson Company, and Cummins & Barnard, Inc., Ann Arbor, Michigan, were the engineers for the power plant.

STEAM at 625 psi and 750 F is generated in a gas-fired boiler with a capacity of 60,000 lb per hr and is supplied to a turbogenerator rated at 1,500 kw with .7 P.F. Process steam is exhausted from the turbine at 15 psig with 15 deg superheat. Any additional process steam required is supplied from a pressure reducing and desuperheating station, where the pressure and temperature are reduced to 15 psig with 10 deg superheat.

Piping at temperatures up to 600 F is insulated with 85 per cent magnesia. Where operating temperatures are higher, insulation consists of either diatomaceous silica or, in most cases, a combination of 85 per cent magnesia and diatomaceous silica. The combination is more economical and efficient than the diatomaceous silica alone in that it takes advantage of the low conductivity of the 85 per cent magnesia. Process equipment is insulated with 85 per cent magnesia alone since process temperatures do not exceed 600 F.

Insulation thicknesses were chosen on the basis of design factors such as operating temperatures, process heat balance, and steam production costs. For equipment operating at temperatures up to 350 F, such as the deaerating heater and vent condenser, 1½ in. was used; above 350 F, for equipment such as heat exchangers, pumps, tanks, etc., the thickness was 2 in.; the vacuum pans required a 3 in. thickness.

Application

Before insulation was applied,

Morton Salt Company's Texas Plant

pipe and equipment surfaces were cleaned of scale, grease, dirt or any other debris that would prevent the insulation from fitting snugly. Loose-fitting insulation cannot give maximum protection against heat loss because air convection currents are set up around the hot surface.

Semi-cylindrical sections, segments or blocks of insulation were butted tightly together and, to avoid a continuous joint from the hot surface to the air, joints were staggered where possible and sealed with insulating cement.

Pipe insulation was wired in place with No. 14 gauge annealed

2-IN. THICK 85% MAGNESIA INSULATION BEING WIRED ON OVER PIPE HANGER.

Pipe Insulation Thickness Schedules

SCHEDULES	PIPE SIZE (Inches)	THICKNESS (Inches)
Schedule A—150 to 250 F		
Water lines to and from heater pumps; to and from make-up pump; and to feedwater heater.	1/2—1-1/2	7/8 85% Magnesia
	2 —3-1/2	1-1/32 85% Magnesia
	4 —6	1-1/8 85% Magnesia
	8 —10	1-1/4 85% Magnesia
	12 and over	1-1/2 85% Magnesia
Schedule B—250 to 350 F		
Lines to and from flash tank; from boiler feed pumps to deaerating heater; supply and return condensate lines to and from pans; to flashers and flasher condenser; condensate return lines from heat exchangers.	1/2—1-1/2	7/8 85% Magnesia
	2 —3-1/2	1-1/32 85% Magnesia
	4 and over	1-1/2 85% Magnesia
Schedule C—350 to 450 F		
High pressure trap piping; steam supply to oil pump; exhaust steam header and supply lines; boiler feed suction lines; boiler feed pump discharge lines; desuperheater to low pressure header; low pressure steam header and supply lines; blow-off lines.	1/2—10	1-1/2 85% Magnesia
	12 and over	2 85% Magnesia
Schedule D—600 to 800 F		
Main steam line from boiler to turbine; supply lines to heater pump turbine, boiler feed pump, pressure reducing station and desuperheater.	1/2—1-1/2	2 diatomaceous silica
	2 —3-1/2	1-1/4 diatomaceous silica
	4 —10	1-1/2 85% Magnesia
	12 and over	1-1/2 diatomaceous silica
		1-1/2 85% Magnesia
		1-1/2 diatomaceous silica
		2 85% Magnesia

CANVAS JACKETS BEING PASTED ON VACUUM PAN AS A FINAL FINISH, AFTER TWO LAYERS OF CEMENT HAVE DRIED. NOTE THAT ONE MAN FOLLOWS UP THE PASTER BY CUTTING THE MATERIAL.

wire, a minimum of 3 loops per section being used. On pipe bends, insulation was fitted by mitering and each mitered piece was wired on separately. All openings at the miters were then carefully filled with an insulating cement to form a smooth, unbroken surface.

Flanges, fittings and valves were insulated to the same total thickness of insulation as that on the adjacent piping. This was considered desirable for two reasons. First of all a significant amount of heat is lost if they are left uninsulated. Secondly, excessive steam condensation is avoided if flanges, fittings and valves are insulated. Blocks and sections were cut to fit the irregular surfaces of this type of equipment, wired in place, and crevices and low spots were filled with insulating cement.

Pipe insulation was finished with a pasted canvas jacket. On lines located outdoors or subject to excessive wetting the insulation was given a special finish. In addition to the canvas, a weather-resistant jacket of asphalt saturated asbestos felt was applied and wired in place with copper wire loops, spaced 4 in. apart. Joints in the jacket were lapped at least 3 in. and were sealed with a waterproof lap cement. Horizontal joints were lapped downward so as to shed water.

Flange, fitting and valve insulation was finished in the same manner as the adjacent insulation, except that asphaltic plastic was used instead of the asbestos felt jacket.

Regardless of the type of finish used, insulation subject to damage by mobile equipment or by other means and on piping passing through floors and gratings was protected by a galvanized metal sleeve or jacket.

Equipment insulation was bound in place with wires, wire cables and bands, the particular type of fastening used depending upon the size and shape of the equipment involved. Flat headed, 3/8 in. stove bolts long enough to extend beyond the surface of the insulation to serve as anchor points for the wiring or banding, were welded to the surface of large diameter equipment, such as vacuum pans, heaters, etc.

Finishing

The insulation was finished with either cement or canvas. For the cement finish, a ½ in. thick layer of asbestos cement mixed with portland cement was applied over expanded metal lath previously wired over the insulation blocks. The lath was further secured by 2 in. x 2 in., No. 22 gauge, galvanized iron washers and nuts screwed on the bolts protruding through the insulation. Where canvas was used, as on the vacuum pans, two ½ in. thick layers of insulating cement were troweled on over the molded insulation, and when the cement had dried the canvas jacket was pasted in place.

Insulation on the cover plates or heads of equipment, such as heaters and exchangers, was cut back so that the bolts can be removed without disturbing the insulation.

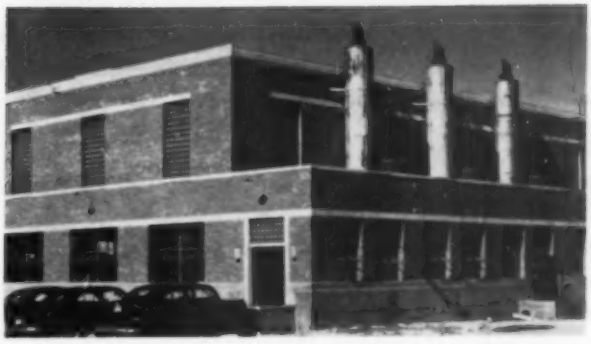
Strap iron edging around openings protects adjacent insulation from damage when covers are removed.

Houston Industrial Show—March 11-17

Planning for the INTERNATIONAL INDUSTRIAL EXPOSITION which will be held in HOUSTON, TEXAS from March 11 through 17, 1951 is now well under way. Exhibits and activities cover oil field operations, chemical industries, refining, and general industrial projects. Included in the last named will be power and its transmission, machine design and manufacture, handling equipment, plant and shop equipment, and the various special services that facilitate industrial operations.

The many demonstrations of services and processes and of equipment in operation, as well as the coordination of research and experimental projects by educational institutions which are cooperating with the exposition management have required months of preparation. Preliminary arrangements for these have been completed to make sure that the show will be a means for the technical and scientific advancement of industry.

The object of the exposition is to provide a means for men in industry to see and study equipment for their particular use. Complimentary tickets are therefore being provided for men in all branches of industry. These tickets are available upon request to Ed G. Lenzner, General Manager, International Industrial Exposition, 41 San Jacinto St., Houston 2, Texas.



DIESEL POWER PLANT OF THE MISSOURI STATE PENITENTIARY, JEFFERSON CITY, MO., PRIME MOVERS ARE THREE IDENTICAL 1,440 HP SUPERIOR DIESELS OF NATIONAL SUPPLY CO.

Life Sentence for Diesels

Nation's largest prison diesel plant, with three 1,440 hp dual-fuel diesels, saves $10,000 on fuel in four months.

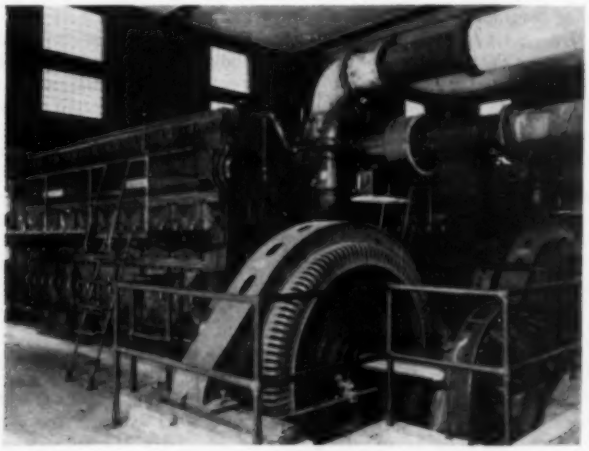
POWER requirements at the Missouri State Penitentiary add up to peak loads of 1,350 kw, with valley loads never less than 700 kw. These requirements were formerly met by two 1,500 kw steam turbines. This should have been an economical arrangement since large quantities of steam were needed for heating purposes. Yet, a study determined that diesels would save the state money even without the utilization of waste heat.

Prime movers are three identical 8 cylinder dual-fuel Superior diesels developing 1,440 hp at 360 rpm.

During the first year, Jefferson City did not have enough natural gas to permit operation of the diesels on gas. However, pipe-line expansion will soon bring the necessary volume. Even with relatively expensive oil as fuel, operating economics were secured. In the first four months, fuel saving totaled over $9,500.

Since the old steam plant provided heat as well as power and since the old boilers are still in use to supply heat, prison engineers calculate the saving by comparing the total cost of fuel for power and heat provided by the steam plant with the combined cost of diesel power and steam heat under the current arraangement. New oil-fired boilers are being installed and the cost picture will be even brighter.

Natural gas will just about double the savings on power, according to an estimate of the penitentiary's chief engineer, L. W. Fitzpatrick. Efficient power production has resulted from the careful operation of good prime movers protected adequately by good auxiliary equipment. Fuel, lube, and air are filtered; water is softened. Many aids to efficient operation are included.



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EACH DUEL-FUEL SUPERIOR DIESEL, DEVELOPING 1,440 HP AT 360 RPM, DRIVES DIRECTLY A 1,000 KW ELECTRIC MACHINERY SYNCHRONOUS GENERATOR WITH V-BELTED 15-KW EXCITER.

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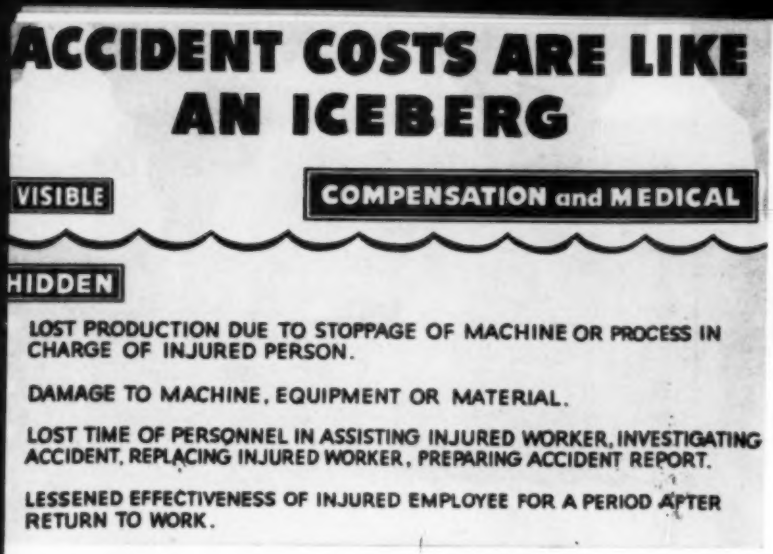

ACCIDENT COSTS ARE LIKE AN ICEBERG
VISIBLE
COMPENSATION and MEDICAL
HIDDEN
LOST PRODUCTION DUE TO STOPPAGE OF MACHINE OR PROCESS IN CHARGE OF INJURED PERSON.
DAMAGE TO MACHINE, EQUIPMENT OR MATERIAL.
LOST TIME OF PERSONNEL IN ASSISTING INJURED WORKER, INVESTIGATING ACCIDENT, REPLACING INJURED WORKER, PREPARING ACCIDENT REPORT.
LESSENED EFFECTIVENESS OF INJURED EMPLOYEE FOR A PERIOD AFTER RETURN TO WORK.

THINK OF DIRECT AND INDIRECT COSTS IN TERMS OF AN ICEBERG. A SMALL PORTION IS ABOVE THE WATER AND REPRESENTS THE DIRECT COSTS. A GREATER PORTION IS HIDDEN UNDER THE WATER AND REPRESENTS THE HIDDEN COSTS. AS IN AN ICEBERG, THIS HIDDEN PORTION MAY EXTEND AWAY BEYOND THE LIMITS OF THAT PORTION WHICH IS VISIBLE. THIS IS ALSO TRUE IN THE CASE OF THE COSTS THEMSELVES.

By
P. A. Springer

Insurance Cost and Value

Direct cost is the premium . . . indirect cost (lost production, machine damage, etc.) cannot be insured . . . an accident costing the insurance company $100 hits you for $400 in indirect cost.

LET'S do a better job in finding a savings of plant dollars from an unexpected source. Insurance company safety engineers provide a service which appears to be gratis. It is a service which is included in the premium which a policyholder pays to their insurance company. But at no time does plant management have distinct feeling that they are paying for this service.

Safety engineers point out that a certain series of accidents is occurring because certain materials or equipment are not being handled in a safe manner. With proper planning, accidents can be kept to a bare minimum and the industrial plant can save materially on insurance and associated costs.

There are **two costs** which must be considered. The first is the **direct insurance cost** or the premium which the individual policyholder has to pay his insurance company. The other cost is what we call the **indirect cost.** This is a cost which must be born altogether by the individual policyholder. There is no way in which this cost can be insured.

Direct Cost

In every case each policyholder is classified according to the operations which they perform. Then through an actuarial process a rate is determined for that particular classification and the policyholder pays so much for each hundred dollar payroll which he develops. It is then fairly obvious to any employer what his insurance is going to cost. However, very early in the history of insurance it became evident that certain organizations would do a lot of work to avoid accidents in their establishment. These plants should then receive some benefit for this work. It was also evident that there would be other plants who would take no steps, whatsoever, to keep accidents at a minimum. These plants should, therefore, be penalized.

So, there was developed what is known as an experience rating plan. This plan covers any particular establishment's record for a three year period. All of the losses occurring during that period are tabulated and modified by certain factors. These are called modified actual losses. For the corresponding period of time the payroll developed by that establishment is also taken and modified by certain other factors. These are called the expected losses. A formula then compares the actual modified losses with the expected losses. If the actual modified losses are greater than the expected losses, a charge will develop. This charge is then applied to the manual rate so that this particular organization will have to pay more for their insurance. On the other hand, if the actual modified losses are less than the expected losses a credit will develop. This also is applied to the manual rate so that this organization will pay less for their insurance.

Some organizations will develop as much as thirty or forty per cent credit regularly. This will mean a substantial saving in the premium which they will have to pay for their insurance. On the other hand, one plant in the Southeast had a charge of one hundred and thirty-six per cent.

Now these are all the direct costs and result directly from the acci-

dents in the individual plant. This is a subject which a surprisingly large number of policyholders are not aware of.

Accidents Affect Costs

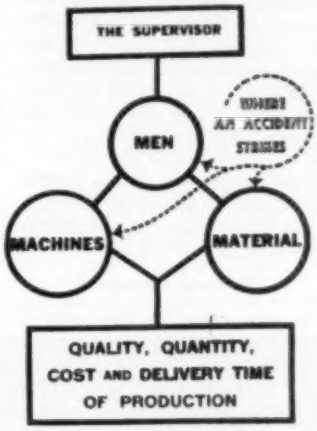
Approximately a month ago I visited a small contracting job in Macon, Georgia. On that particular morning one of the partners of the business had received a notice that an award of approximately three thousand dollars had been made to one of his employees. He was a little upset about this because the man apparently suffered a stroke from natural causes and was not in any way related either to his work or to his occupation. We discussed this for a few minutes and then he very casually dismissed the whole subject by saying something to the effect of *"Oh well, you people will pay for this for me"*. I immediately took this occasion to discuss this question of experience rating with him and pointing out how such an accident would adversely affect the cost of his insurance. As soon as he realized this, he quite naturally took an entirely different point of view on this accident and hoped that we would take every step possible to see that this was not charged in his experience unless it actually belonged here.

Indirect—Direct

A good many years ago the National Safety Council, which is an organization, that correlates most of our safety information, brought out a set of figures indicating that the indirect cost was four times the direct cost.

In other words, if an accident cost the insurance company one hundred dollars the policyholder paid out four hundred dollars in indirect cost.

Now by direct cost we mean the injured employee's hospital bills, medical attention, and compensation while he was away from his job and not receiving his regular wages. By indirect cost we mean all the other charges which could be laid to any particular accident.



IN ORDER TO GET PRODUCTION, A PLANT HAS THREE MAIN ELEMENTS WITH WHICH TO WORK—MEN, MACHINES AND MATERIALS. AN ACCIDENT MAY STRIKE AT ANY ONE OF THE THREE.

These might include material that was spoiled, machinery that was damaged, the loss of time of the supervisor taking the injured person to the doctor or hospital, to the loss in productive time of employees who gathered around to see the accident.

There have been many organizations who have run their own indirect cost figures. One plant in Louisiana found that their indirect cost was approximately sixteen times the direct cost. There have been other plants which have gotten it down to about two to one.

Now this is a subject which we, as safety engineers, have very frequently talked over with various policyholders. While assisting a plant in Augusta, Georgia, with their accident prevention program one of our men had discussed this particular subject with the plant manager and again at a meeting of all of the foremen. They were all vaguely aware of what he was trying to tell them. But as you all well know, until a point is actually driven home it seems only to be a subject about which we talk.

About a month ago, this plant had a very serious injury. One of the women lost her arm in one of their machines. In this particular case the word of this accident seemed to have gone through the plant like wild fire. By the time that the ambulance had arrived nearly everyone in the plant had gathered around the windows to see the injured woman carried away. Throughout the rest of the day, very little work was done by the employees.

On top of that it took two of their plant maintenance men two days to tear the machine apart, clean it up, make the necessary repairs and put it back into operating order. The next time our safety engineer visited this plant all of the people pointed out to him that they were

THE INDIRECT COST IS FOUR TIMES THE DIRECT. DIRECT COST IS THE INJURED EMPLOYEE'S HOSPITAL BILLS, MEDICAL ATTENTION, COMPENSATION, ETC., WHILE HE WAS AWAY FROM HIS JOB AND NOT RECEIVING HIS REGULAR WAGES. INDIRECT INCLUDES ALL OTHER CHARGES—MATERIAL THAT WAS DAMAGED, LOST TIME OF OTHER EMPLOYEES, ETC.

BASED ON A NATIONAL AVERAGE

YOUR INSURANCE COMPANY PAYS *"VISIBLE" COSTS*

YOUR EMPLOYER PAYS *4 TIMES AS MUCH* IN *"HIDDEN" COSTS*

now fully aware of this indirect cost. They further estimated that in this particular case the ratio was probably greatly in excess of the four to one ratio.

Materials Handling

Let's think in terms of material handling. Several years back we insured a series of plants fabricating a product from light tin plate. They used industrial power trucks to a great extent in trucking through freight cars. That is, they would have one freight car beside the dock and then there would be another car on the adjacent track. The truck would go from the dock through the first car into the second car. Approximately once each year one of these trucks would slip off the gang plates and fall either between the car and the dock or between the two cars. Usually the truck was severely damaged and in many cases the employee operating the truck was killed. There was also damage to the finished goods and often the shipment was delayed. Here is another very dramatic case of where the indirect cost can be very high and in this particular case it is specifically one of materials handling.

Accidents from handling are high. Figures compiled from an analysis of seven states indicate that accidents through **handling**, accounted for twenty-five per cent of the injuries. The next highest causes listed were those resulting in **falls** which accounted for nineteen per cent and those from **machinery** which accounted for twelve and one-half per cent.

Considering the various factors in materials handling can do much to cut the insurance part of the operating or production cost.

Property Damage

In some cases we have had in addition to a personal injury some property damage.

As safety engineers we like to consider any incident or occurrance which interrupts the smooth flow of production as an accident. Production is the turning out of a given product in a given quantity of a given quality at a given cost. So any occurrence which effects any of these items could be considered as an accident whether it results in personal injury only, or property damage only or a combination of both.

For instance, we may have a factory involved in the manufacture of a fragile material such as glass globes, bottles or the like, and should an employee drop some of these and break them, this can be called an accident.

We may also have an accident in which there is both property damage and personal injury. In either accident noted previously—where the woman lost her arm in the machine or the truck which fell between the cars—there was **both** personal injury and property damage.

Every accident, whether it be one involving only personal injury or one involving personal injury and physical damage or only physical damage, has **two parts which are in common.** The first is the **cause** and the second is the **result.**

You may have a man climbing a ladder to replace a light bulb. He may fall. In one case he may dust his clothing off and walk away with no physical injury. In a next case with almost identical conditions, he may fall in such a way as to strike his head and be fatally injured. In these two cases the result may be entirely different, however, the cause could have been the same. The ladder may not have been provided with safety feet or it may have had a broken side rail or a split rung or any one of such defects. The cause is what we are primarily interested in and on which we can set up measures for control. In the same way many material handling methods may be the cause of accidents.

In controlling an accident there are two factors which we must keep in mind, and which will be present in every accident. These are **motion** and **contact.** In other words, if we had no motion whatsoever, we would never have occasion to have an accident. If you sat in a chair and would continue to sit there and not move, nothing would happen. However, should you move in that chair enough to shake it and the chair was wobbly it might let you fall toward the floor. I said toward the floor because if there were no contact with the floor and you continued falling

New Officers of P. E. P. A.

O. C. Bailey, Chairman of the Arkansas Oil & Gas Commission, is shown (right) congratulating **R. E. Patrick,** Kansas Gas & Electric Co., Wichita Kansas, upon his election to the presidency of the **Petroleum Electric Power Association** at the 22nd annual meeting held recently in Hot Springs, Arkansas. Others in the photo are **T. E. Graham,** (left) Oklahoma Gas & Electric Co., Oklahoma City, Vice-President and **Ned W. Beaudreau,** Central Power & Light Co., Corpus Christi, Texas, Secretary-Treasurer.

indefinitely through space, there would be no accident. However, as soon as you strike the floor you have made a contact and a possibility of an injury or an accident has occurred.

In the **consideration of contacts we have two kinds.** These are **controlled** and **uncontrolled.** In a manufacturing plant, we may be forging tools. The piece of metal is heated red hot and placed under a hammer where it is forged into the particular shape desired. This is a typical example of a controlled contact. A minute ago I mentioned dropping a glass bulb onto the floor and breaking it. This is a contact which occurs in the process and is not planned in the particular operation. This is uncontrolled contact.

In your materials handling problems you are definitely involved in motion and in contacts. Where you are considering these problems it is essential that your motion and your contacts be so planned and so designed or so arranged that only those which you desire will come to pass.

Safety engineers cannot go into a plant and tell them that they should do a certain operation in a certain way. The job is to take the particular operation being performed and make it as safe as possible. For instance, if a man injuries his back lifting a heavy object the job is to point out the proper methods for lifting. A power truck, crane, or other device may be suggested and the fact that the recommended weight for a man to lift is seventy-five pounds.

With the proper type of planning, motion and contacts can be controlled. Accidents can be kept to a bare minimum and the plant can save materially on their insurance and associated costs.

Atlantic Steel Increases Capacity

The **Atlantic Steel Company, Atlanta, Ga.,** is launching a three-year expansion program that will increase its steel-making capacity fifty per cent and double its output of rolled products, according to **Robert S. Lynch,** president of the company.

"We are entering into this program for two reasons," said Mr. Lynch. "First because of the accelerated national defense program, and secondly because of the continuing industrial expansion in the South."

The new program, to be financed by private capital, follows on the heels of a two-million dollar four-year post-war modernization and improvement program that has greatly widened the scope of products, facilities and services offered by the Atlantic Steel Company.

First phase of the three-year program will be the installation of a **60-ton electric furnace** at a cost of approximately $1,500,000. It is estimated that the new furnace will produce a minimum of 100,000 tons of steel annually.

The present rated capacity of Atlantic Steel Company's three open hearth furnaces is 188,000 tons. But this year the company will produce more than 200,000 tons of steel, to set an all-time production record.

It is expected that the new furnace will be completed by December, 1951.

Second phase of the company's expansion program, to begin when the new furnace is completed, will be the addition of a **new rolling mill** which will make it possible for the company to produce a wider range of sizes and types of steel bars and shapes.

The new furnace will be the first large electric furnace in the entire Southeast. Besides having a production rate nearly twice as great as the same size open hearth furnace, the new furnace offers important savings in alloys, such as chromium and manganese, used in the production of steel.

An important advantage to the Atlantic Steel Company, which operates no blast furnaces and depends on out-of-state sources for pig iron required in open hearth operations, is that it is not necessary to use pig iron to produce steel in the electric furnace.

The output of the new furnace, when it is completed, will not only increase the production of various rolled products, but will also enable other finishing departments to operate at capacity.

The Atlantic Steel Company now operates three open hearth furnaces, a blooming mill, rod mill, wire mill, two narrow strip mills, various wire products departments, as well as heat-treating, galvanizing, forging and stamping facilities and supplementary operations. Many of its products are marketed throughout the South under the trade-name of "DIXISTEEL".

DON'T SPIN BEARINGS BEFORE CLEANING. ENTRAPPED DIRT CAN CAUSE SERIOUS SCRATCHING.

Maintenance of Anti-Friction Bearings

By E. P. Stahl
The Garlock Packing Company

Part 2—Cleaning, Purging and Lubrication

The problem of applying the proper lubricant to the bearings and retaining it in the bearing housings is often more complicated than selecting and mounting.

MAINTAINING a high rate of production on present day equipment is dependent upon operation, lubrication and maintenance. Each of these is a specialist's job.

With heavier bearing loads, higher speeds and higher temperatures in modern industrial equipment, bearing lubrication has become a complex problem. This is especially true if four or five different lubricants are to be applied on a single machine at proper intervals.

The matter of applying these lubricants, cleaning filters, repairing lubrication pumps, piping, etc., should be placed in the hands of especially trained lubrication personnel.

The cost of good lubrication of ball and roller bearings is insignificant when compared to maintenance cost, value of equipment serviced or material produced. Therefore, it is to the best interest of management to spend cents on lubrication to save dollars in maintenance.

Maintenance and shop men should remember that there is no relationship whatever between lubricating plain sleeve type and anti-friction bearings. The latter are generally used with tight seals. Forcing grease into them under high pressure with a grease gun, as with a plain bearing, may burst the seals.

The bearing will then leak until the seals are repaired. This practice is also likely to produce an overloaded bearing. If the bearing space in the housing is completely filled with grease, the balls or rollers have to force their way through it causing grease friction, overheating and eventual failure of the bearing.

Cure for the condition is to sup-

Notes on Preventive Maintenance

Proper lubrication is an inexpensive form of preventive maintenance. A relatively small quantity of lubricant will suffice if consistently present at the right place and the right time. More trouble frequently develops from excessive lubrication than from too little.

Store all lubricants in tightly covered cans or containers. When bearings are to be lubricated, all grease fittings, oil cups, grease inserting tools and spouts and covers of the containers should be carefully wiped clean.

Bearings subjected to high speeds and high temperatures are generally lubricated with oil; under moderate conditions with grease, since relatively simple closures can be used to retain the grease within the housing. The grease also acts to increase the effectiveness of the seals in excluding dirt.

Grease lubrication is generally more foolproof than oil, as the original charge of grease need not be replenished at frequent intervals.

Approximately 90 per cent of all anti-friction bearings in use today are lubricated with grease-form products. Calcium, potassium and aluminum soap greases are generally limited to the action of slow speed and moderate temperature and where frequent lubrication is permissible. Soda or soda calcium soap greases are usually preferred for a wide range of speeds and temperatures and are used in most ball and roller bearing applications. Recent experience indicates that lithium or lithium-soda soap greases will operate successfully over temperature range now served by soda base greases and in addition are water repellent.

Principal requirement of oil used is that it have good stability or resistance to chemical breakdown. When selecting lubricants consider: housing design, operating temperatures, speed, load, size, method of application, and moisture conditions.

ply a vent at some convenient position in the housing or to equip the bearing housing with a grease pressure relief fitting. Several of these housings were illustrated in Part I of this discussion.

Relieve all bearing seals of all possible pressure to reduce leakage to a minimum and to eliminate possibility of blowing the seals out of the housing. "Air Cushions" might occur, for instance, if the bearing housing is filled with cold and heavy oil, which is not able to penetrate into the space between the bearing and the seal. Hence, air which remains cannot escape but will be heated when operation starts and expands so that oil is pressed away, with the risk of the seal running dry. It is advisable to make a hole or groove to connect the space in front of the seal with the inside of the bearing housing. These ducts should, of course, be situated above the oil level.

Due to centrifugal force, certain bearing types such as tapered roller bearings and large cylindrical roller bearings, might have a pumping effect on the oil. Depending on the application, oil is pumped away from or toward the seal, creating undesirable vacuum or pressure, as the case may be. To facilitate oil circulation one or several oil ducts or return drains should be made under the oil level. At high speeds such oil ducts or return drains are recommended, as the ball or roller cage might prevent oil from circulating. If the oil has to pass through several bearings before reaching the seal, oil ducts or return drains are preferable even at low speeds.

Purging Bearings

Manufacturers emphasize the necessity of draining or washing bearings in a machine at regular intervals whenever and wherever possible, to be followed by the replenishment of fresh lubricant. It pays big dividends in the long run.

Solid matter not of an abrasive nature tends to clog oil passages and ducts and the bearings themselves causing excessive wear and friction. It also interferes with the free action of balls or rollers. Gummy deposits formed from oxidation of the lubricant when subject to high temperature and speed conditions act in a like manner. To get the expected life cycle out of ball and roller bearings, purge them or flush them out at regular intervals.

For cleaning bearings without dismounting, hot light oil at 180 F and 200 F may be flushed through the housing while the shaft or spindle is slowly rotated. In cases of badly oxidized grease and oil, hot aqueos emulsions (made with grinding, cutting or floor cleaning compounds, etc.) may be run into the housings, preferably while rotating the bearings until satisfactorily cleaned. The solution must then be drained thoroughly, providing rotation if possible, and the bearing and housing flushed with hot, light oil and again drained before adding new lubricant. In some very difficult cases an intermediate flushing with a mixture of alcohol and light mineral solvent after the emulsion treatment may be useful.

High temperatures in oil lubricated ball and roller bearings such as encountered in paper machinery and steel mills cakes the oil so that oil passages are often plugged. In such circumstances, it is not always necessary to shut down and dismantle the equipment. It is often possible to clean a circulating system by circulating a selected high flash solvent, at rela-

How Much and How Often

How much grease and how often to apply it is a problem that has always perplexed factory men and shop maintenance personnel. A properly lubricated ball or roller bearing should be about one-third full in the bearing space. The following may serve as a guide.

Shaft Extension (Dia. in inches)	Weight of Grease to be Added (Ounces)
¾-in. to 1-¼-in.	¾
1-¼-in. to 1-⅞-in.	1
1-⅞-in. to 2-⅜-in.	2
2-⅜-in. and over	3 or more

Note: 1 oz. equals 1-¼ cu in.

No iron clad rule can be followed regarding the frequency of application. However, in extremely heavy duty service, relubricate bearings every two or three months. In lighter service the intervals vary from six to nine months. In some other applications bearings need no attention except for yearly cleaning and relubrication.

Ball or Roller Bearing Lubricants

One of the major advantages of anti-friction bearings over plain sleeve type is that they require lubrication infrequently. However, the lubrication job can not be haphazard. Ball or roller bearing lubricants:

1. Provide a tenuous lubricating film between the bearing separator and cage parts.

2. Dissipate heat caused by deformation of load carrying members and separator or cage.

3. Prevent rust or corrosion of the bearing parts.

4. Aid in protecting the bearing against dirt, water, acid fumes or other foreign matter.

Oil provides the best lubricating medium for ball and roller bearings despite the fact that more than 90 per cent of the bearings in use today are lubricated with grease. Choice depends on the type and design of equipment to which bearings are applied.

Grease lubrication is usually recommended over free-flowing oils in the following applications:

1. Where the bearing application would result in excessive oil leakage thus staining, damaging or contaminating the finished product.

2. In designs and devices that do not prevent the entrance of grit or water.

3. Points where the application of a lubricant is infrequent, hazardous or inaccessible.

4. Low operating speed and heavy pressure applications.

tively high temperature through the system thus making it possible to clean up the equipment and resume operations.

In pillow blocks and other isolated bearing applications where the grease fitting is on one side and the drain plug on the other, the drain plug can be removed and fresh grease forced through the bearing to purge any remaining contamination. The bearing should then be operated for at least twenty minutes before the drain plug is replaced as excess lubricant will cause overheating of the bearing.

In the case of inaccessible bearing locations where this procedure cannot be followed, it may be desirable to use pressure relief fittings in the bearing housings to prevent over-greasing of the bearing.

Do Not Over Lubricate

An excess supply of oil or grease is not recommended for ball or roller bearings. Heat is generated more often by too much lubricant than by too little. The risk of under-lubrication of ball or roller bearings is obvious. But the dangers of over-lubrication are even more serious, resulting in power losses, overheating caused by internal friction and excessive wear and wasting of lubricant. Every precaution should be taken by maintenance men and shop men to guard against over-lubrication of ball and roller bearings.

The proper selection, care, and segregation of various ball and roller bearing lubricants is a must in every efficiently run plant. To prevent mis-use and mis-application of lubricants, properly trained personnel should handle them. Every lubricant container should be properly labelled. Using only one type of grease in a gun and having the gun carefully marked will help prevent the grease designated for one type of bearing from being used on another, requiring a different grease.

Every plant should have a regular schedule or time table for inspection and re-lubrication of its equipment. The bearing manufacturer or the manufacturer of the equipment involved will specify the service requirements and schedules.

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Part 3 in the March issue of Southern Power & Industry will deal with procedures to be followed in removing bearings from service and their re-installation.

REFRACTORIES for Wood Waste Boilers

Faced with increased steam demands and less waste fuel, woodworking plants are redesigning their furnaces to meet the new requirments

By Walter B. Bryant
Jacksonville, Florida

A NUMBER of current trends emphasize the need for more scientific utilization of wood waste as fuel. First of all modern woodworking plants are reducing their waste and increasing the use of power. So better combustion efficiency is essential to prevent the necessity of purchasing fuel. Better efficiency means higher furnace temperatures, and higher temperatures mean increased refractory maintenance. These conditions, together with the fact that the cost of refractories has increased greatly, clearly indicate the need for real engineering in design and operation of wood burning installations.

Higher Refractory Cost

Thirty years ago No. 1 fire brick could be bought for around $45.00 per thousand plus freight, fire brick masons could be hired for between $1.00 and $1.50 per hour, and helpers from 50 to 75 cents per hour; and in addition the brick mason was not considered worth his salt unless he laid straight wall at the rate of 1000 bricks in an 8 hour day. Today a good No. 1 fire brick costs $86.00 per thousand F.O.B., the brick mason commands $2.50 to $3.00 per hour, and if he lays 700 to 800 brick per day that is considered satisfactory. With such costs, the short life of the refractory lining in a boiler furnace due to improper burning of wood refuse is a factor well worth considering.

Requirements Differ

Most of the confusion in the burning of wood and the wrong application of refractories has been due to a tendency to consider all wood burning installations as similar. Actually, efficient and economical burning of this fuel involves fairly complex considerations. But the problem may be simplified by dividing it into two general headings, with several subheadings under each:

A. Plants where the wood refuse **supply exceeds the demand** for steam and the furnace acts partly as an incinerator. Fortunately this type of plant can be divided into two classes.

1. Sawdust and slabs where logs have been floated to the mill, and stored in mill ponds. This refuse will contain from 60% to 70% moisture.
2. Where logs have been transmitted to the mill dry. This refuse will contain 30% to 60% moisture.

B. Plants where the wood refuse **does not exceed the demand** for

steam in prime movers and dry kilns, thereby bringing about a desire for efficient combustion of the waste fuel. Again this type can be divided into two classes.

1. Refuse from planing mills where lumber has been air dried and the refuse will contain 15% to 30% moisture
2. Refuse from furniture factories where refuse will contain between 5% to 15% moisture.

To properly evaluate fuels of these four moisture contents, we must consider the furnace temperatures that can be theoretically reached, using refuse having different percentages of moisture and admitting different percentages of excess air for combustion. Figure 1 has been plotted to show the maximum temperature to be expected from burning fuels of each class enumerated above, namely: A-1 = 60% to 70% moisture; A-2 = 30% to 60%; B-1 = 15% to 25%; and B-2 = 5% to 10%. The family of curves shows temperatures to be expected under each condition with excess air ratios varying from 0 to 100%.

Choice of Refractory

The writer does not know of any type of fuel for which the selection of the refractory lining covers such a broad field as in the burning of wood refuse. I have visited saw mills in Virginia where the operator was satisfied with red clay dug out of a hillside for the lining of his furnace, and I have visited plants in Detroit and Grand Rapids, Michigan, where 60% alumina brick was considered most adaptable to their furnace conditions. I believe that Fig. 1, when carefully studied, illustrates this fact better than could be done by many paragraphs.

The ultimate analysis and calorific value of dry wood averages as follows: Carbon 49.56, Hydrogen 6.11, Oxygen 43.83, Ash 0.42, Btu value 8670. The proximate analysis of moisture free wood refuse is volatile matter 81.5%, fixed carbon 18.0%, ash 0.5%.

The unusual characteristic of this analysis is the high oxygen contents. None of the standard fuels has such a high oxygen content as wood and consequently the air required for complete combustion is correspondingly low. Natural gas requires 15.9 lb oxygen per lb of fuel, oil 14.0 lb, coal 11.0 lb, and wood only 6.0 lb of air per pound.

Because of the high flame temperature reached when burning dry wood with little excess air a refractory with a high softening point is indicated. While the percentage of ash is low, its silica and alkaline characteristics form a low temperature fusion slag which readily fluxes with silica. Consequently a refractory having high alumina content is desirable.

Method of Application

The above points to either a super duty fire brick or a super plastic as a lining for wood burning furnaces. Having settled the type of refractory, the method of application comes up next for consideration.

First we must consider the grate area. Here we have two factors to consider which have not been well established. But let us assume: 35 sq ft of heating surface per sq ft grate surface, and 30 lb of shavings per sq ft of grate surface per hour. Let us take one of the most common boilers used in the lumber trade: 150 hp H.R.T. boiler, 3½" tubes, heating surface 1453 sq ft. With 35 sq ft of heating surface per sq ft of grate area this equals 41.5 sq ft, or a grate 6′0″ x 7′0″.

One boiler horsepower equals 33,475 Btu per hr which at 70% efficiency requires 47,800 Btu per hr. One hundred and fifty horsepower at 150% rating equals 225 bhp. This times 47,800 equals 10,775,000 Btu. Assuming the Btu value of dry wood at 8,670, we will burn 1,240 lb shavings per hour. Using 30 lb shavings per sq ft of grate surface, we arrive at 40.3 sq ft, or a grate 6′0″ x 7′0″. So the two methods check.

The latter premise seems to lend itself to greater accuracy because the Btu value of the fuel varies with the percentage of moisture.

TABLE NO. 1

Per cent Moisture	Available Heat Btu/lb	CO_2
Dry	8670	20%
20	6564	16.8
40	4628	14.8
60	2792	12.5

No two authorities agree as to the number of pounds of shavings that can be burned per sq ft of grate surface; this factor varies from 30 to 60 pounds per sq ft. This variation is accounted for when we consider that a cu ft of shavings containing 60% moisture will weigh considerably more than a cu ft of dry shavings.

In addition, there are other limitations which govern the maximum allowable grate area:

(A) Grate width is determined by the width of the boiler.

(B) Where shavings are fed by hand through the front doors, the effective length does not exceed 10′0″.

(C) Where a dutch oven is used, and the shavings are fed through an opening in the crown of the arch, the location of the front of the bridge wall is determined by the angle of slope assumed by the shavings when dropped through the opening.

Limiting Factors

In the consideration of any type of refractory lining there are certain limiting factors both of operation and of design which must be taken into account:

First: Due to the high percentage of oxygen inherent in the fuel itself, it is theoretically possible to carry as high as 20% CO_2 with no excess air and develop a furnace temperature of 4100 F. Since this temperature is too high for refactories, it is necessary to employ some excess air to limit the temperature—the amount of excess depending on both the fuel and the fire brick used. Thus, efficiency must be sacrificed to keep maintenance within reasonable limits.

Second: While it is admitted that the following is based on rule of thumb, it has the backing of years of experience. A Missouri first quality high heat duty fire brick should not be installed where the Btu release per hour per cu ft of furnace volume exceeds 20,000 Btu per hour. If the calculation of the Btu release shows 20,000 and and 30,000 a super duty fire brick or super plastic should be used. Above 30,000, a 60% alumina brick should be installed, with prayers.

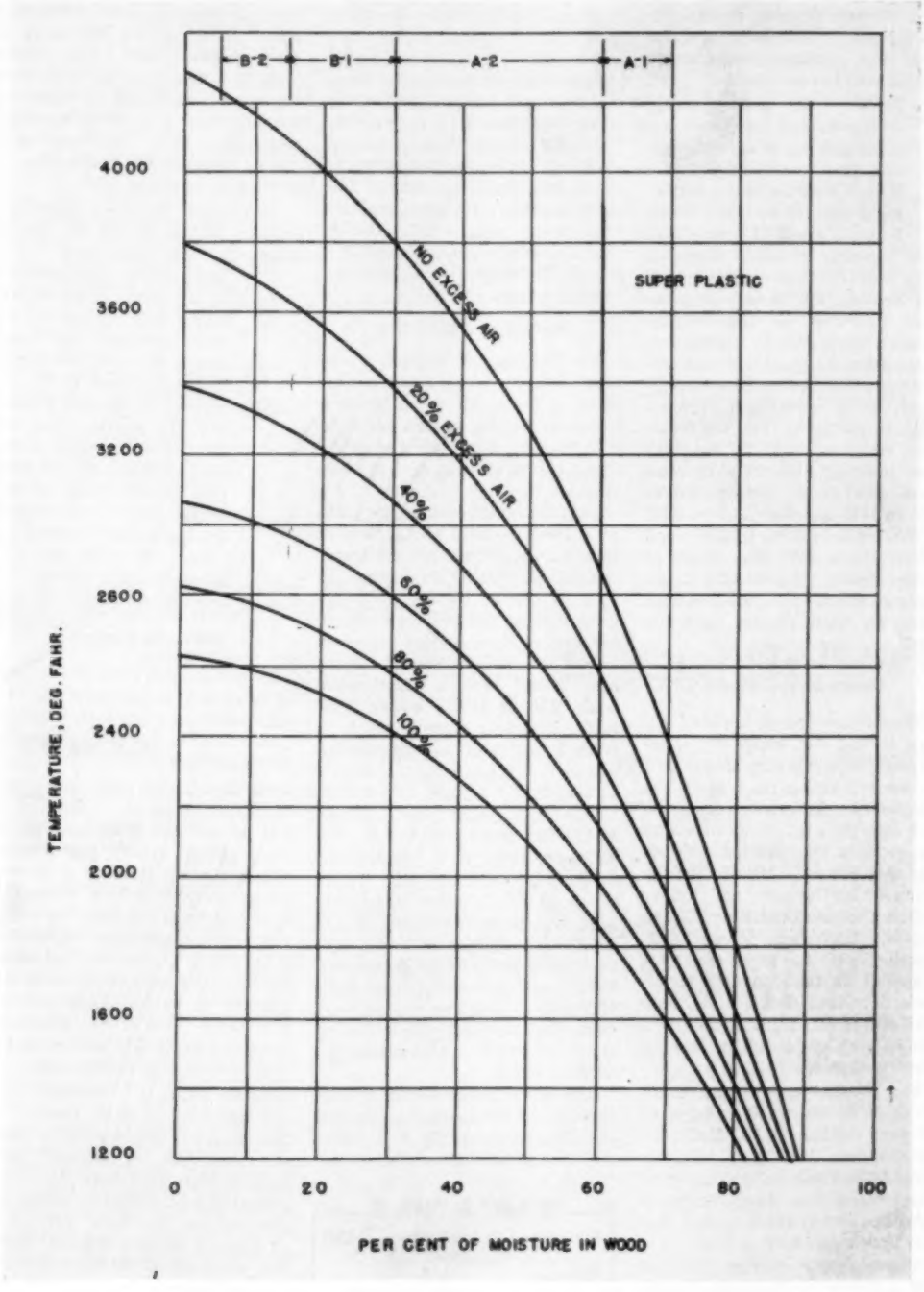


FIG. 1. COMBUSTION TEMPERATURES WITH WOODS OF VARIOUS MOISTURE CONTENTS

It should be understood that the statements given above refer to solid wall construction. If hollow wall construction is used the skin temperature of the fire side of the wall will be reduced, and higher values can be used.

Third: If the boiler is an H.R.T., the question of how much of the volume back of the bridge wall can be considered effective furnace volume is a subject for argument. The writer has always used one third with no more justification than a desire to play safe. We certainly don't want combustion to take place at the point where the gases enter the boiler tubes.

Type of Setting

Whether the setting should be flush front, or Dutch oven, depends primarily on the moisture content of the fuel. Referring to Fig. 1, plants of type A-1 and A-2 are Dutch oven plants. Type B-1 may be flush or Dutch, and type B-2 would be flush setting. In order to burn wet refuse the moisture must first be driven off and this is accomplished by the radiant heat reflected from the incandescent refractory arch of the Dutch oven.

Oven-fire Air

We now come to a phase of burning wood refuse that has never been given sufficient emphasis except in the larger plants—the introduction of preheated air over the fire. Preliminary tests which were made by the writer and Lester Cockburn of the Fisher Body Corporation at Plant 10 around 1925 supplemented by Charles S. Gladden, then Director of Power and Maintenance Section of General Motors, proved that the introduction of preheated air over the fire was essential for the proper combustion of wood waste fuel.

Unlike other fuels wood waste burns from the surface down. If an attempt is made to introduce sufficient air through a heavy bed of such fuel, small crafers will be formed and spotty burning will take place. This spotty burning of the fuel causes the formation of CO instead of CO_2. This was proved at Fisher Body Plant 10 where as high as 5 to 6% CO was found in the products of combustion. When one of the front doors was opened this CO disappeared and the percentage of CO_2 became higher. This admission of cold air over the fire killed the steaming of the boiler, but the procedure proved conclusively that the solution of the problem was the admission of preheated air over the fire.

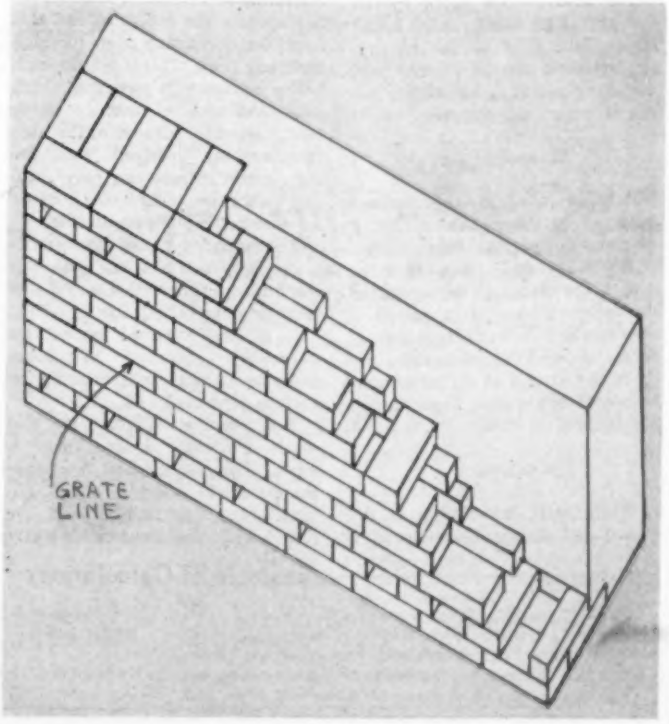
This method was later employed by Mr. Gladden in such plants as the Hammond Lumber Co., Samoa, Ga., Chevrolet Motor Co., St. Louis, Mo., Fisher Body Corp., Detroit, Mich., General Motors of Canada, Oshawa, Ont., Canada, and Rudolph Wurlitzer Co., North Tonawanda, N. Y. It must be borne in mind that the tests run at Plant 10, Detroit, were not motivated by any desire to increase the efficiency of the furnace but to reduce the high refractory maintenance of the flat arches.

The causes of this high maintenance was demonstrated to the writer by Paul Grunnert, Comb. Engr. for Commonwealth Edison Co., in one of their plants. Grunnert took samples of the gases of combustion over the face of a flat arch where Illinois coal was burned on a chain grate stoker. Analysis of the gases showed that wherever there was bad grooving of the arch, a high percentage of CO was present at that point. The tests at Fisher Body followed and proved that as far as the burning of wood refuse was concerned, the introduction of preheated air over the fire eliminated the high maintenance costs.

In the case of the large plants mentioned, pressure blowers were installed to overcome the resistance in the hollow side wall construction of these large boilers. In the case of sawmills, finishing mills, and small furniture plants, the introduction of blowers and the instruments for adjusting the air fed over the fire in the majority of cases seems hardly justified, not to mention the personnel required for operating the boilers.

To take care of such conditions the writer, some years ago, evolved a simple hollow wall construction

FIG. 2. DIAGRAMMATIC SKETCH SHOWING ADMISSION OF PREHEATED AIR OVER FIRE FROM UNDER THE GRATES



made from 9" series fire brick, which, while no claim is made to increasing the efficiency, does lower the maintenance cost of the setting. Air is drawn from the ash pit, carried up inside the side walls and preheated, then introduced into the furnace over the fire.

The operation of this construction is more or less automatic. If the thickness through the fuel bed is such that the resistance of the passage of air through the grates is less than that through the hollow wall all the air will go through the grates. When the thickness of the fuel bed reaches a point where this condition is reversed, sufficient air will be fed up through the side walls to maintain the excess air required for low refractory maintenance.

This type of construction is shown in Figure 2. Five courses of brick are below the grate line and six above. The wall extends from the front wall to the face of the bridge wall. Nine inch straights and soaps are the only brick required in the construction. In order to stabilize the construction the wall is tied together every second course with header brick spaced 9" apart. These header brick break the straight flow of the air upwards, slow down the velocity, and promote preheating of the air before it enters the furnace.

Amount of air

In order to hold the furnace temperature down below 3200 F we must not permit the excess air to fall below 40%. This being the case, a knowledge of the weight of air required to burn a pound of shavings at different percentages of excess air, and the volume of air in cu ft per pound at different temperatures is of value. These factors are covered in Tables No. 2 and 3.

Conclusion

While each installation is different and should be analyzed as a specific problem, there are a few generalities that may save time and and aid in choosing the right approach.

First: efforts toward high efficiency should be governed by the steam demand in respect to fuel supply. There may be little advantage from installing a high efficiency boiler unit, if an incinerator is required additionally to dispose of excess waste fuel. **Second:** moisture content of the fuel determines the type of setting. Sufficient heat reflecting surface must be provided to vaporate the moisture and this necessitates a dutch oven for high moisture fuels. **Third:** where high boiler economy is indicated, high grade refractories usually prove most desirable, because of the high temperatures involved. And the high grade refractories may actually be cheaper in first cost because a lower setting is permissable.

The various types of sawmill operations establish three principal conditions under which waste fuel burning may take place:

1. A simple closed incinerator (no steam generation) to dispose of waste without contaminating the surrounding area.

2. A combination incinerator and steam generator where there is more than enough fuel to supply the steam. In this case boiler efficiency is unimportant.

3. A waste fuel fired boiler where no excess fuel is available. Here good boiler efficiency is essential to eliminate or reduce need for purchased fuel.

In the case of the independent incinerator, proper design is just as essential to insure low refractory maintenance as with the boiler, with the exception that there is no restriction with regard to width or length. Too often some jack leg who has no knowledge of combustion builds the unit and the results are far from satisfactory.

Where the boiler and furnace act as an incinerator as well as a steam generator, the furnace volume must correspond to the maximum amount of waste products to be burned and provision must be made for the admission of sufficient excess air to hold the furnace temperature down and prevent the safety valves from working overtime; and also to prevent high refractory maintenance.

Lastly, where the waste products closely parallel the demand for steam, economical operation of the unit becomes an important factor. Furnace temperatures must be relatively high and excess air relatively low to give maximum steam production. And under these conditions design of combustion equipment and selection of refractories must be carefully handled to avoid high refractory maintenance.

TABLE NO. II

Weight of Air Required to Burn a Pound of Shavings

Per Cent Excess Air	0	20	40	60	80	100
Wt Air in Pounds	6.08	7.30	8.51	9.23	10.94	12.16
Wt Combustion Gas	7.07	8.28	9.50	10.22	11.93	13.15
% CO_2	20.00	16.80	14.30	12.50	11.10	10.00

TABLE NO. III

Volume of Air in cu ft per lb at Various Temperatures

80 F	13.6 cu ft	200 F	16.6 cu ft	400 F	21.7 cu ft
100	14.1	220	17.1	500	24.2
120	14.6	240	17.6	600	26.7
140	15.1	260	18.1	700	29.2
160	15.6	280	18.6	800	31.7
180	16.1	300	19.1	900	34.2

Example of Calculations

It is usually helpful as an amplification to the text of an article to work out a problem illustrating the various factors involved. The writer has no intention of assuming the duties of the consulting engineer. There are so many variables that enter into the design of a boiler setting that the following must be considered only as a guide.

Assume a 150 hp H.R.T. boiler 72" x 18'0", heating surface 10 sq ft per bhp, flush front, overall

length of setting 23'6", efficiency 70%, 150% rating, planing mill, shavings 20% moisture content, weight of saw dust 40 lb/cu ft, estimated temperature of preheated air 140 F, Btu input per bhp 33.475. Super duty fire brick to be used.

Btu input required.

$$\frac{150 \times 1.50 \times 33.475}{70} = 10{,}755{,}000 \text{ Btu per hr.}$$

Pounds of fuel burned

From table 1 we see that 20% moisture fuel has an available heat value of 6564 Btu.

$$\frac{10{,}755{,}000}{6564} = 1{,}638 \text{ pounds burned per hr}$$

Grate surface

Assuming 30 lb shavings per sq ft grate surface we have:

$$\frac{1{,}638}{30} = 54 \text{ sq ft grate surface, or a 6 ft wide by 9 ft long grate}$$

Furnace volume

At this point we must decide whether we will use a Super Duty or a No. 1 fire brick as this determines the allowable Btu release per cu ft furnace volume. Refering back to "Limiting Factors" second item we have an allowable Btu release of 30,000 Btu for Super Duty and 20,000 Btu for No. 1 fire brick. So the volumes for each type would be:

$$\text{Super Duty} = \frac{10{,}755{,}000}{30{,}000} = 538 \text{ cu ft}$$

Determining Dimensions

The writer knows no easy method for determining the dimensions of an H.R.T. setting to meet the requirements of a certain predetermined furnace volume.

The width of a 72" H.R.T. is 6'-0" We have assumed an overall length of 23'-6" flush front setting. The grate length, as previously stated is 9'-0". The bridge wall is 2'10" thick. The front and rear walls are 18 in thick. This gives us 9'-6" for the length of the combustion chamber. How much of the combustion chamber may be effective has been dealt with under the heading "Limiting Factors" paragraph three, and for this example we will use one third as given there.

In calculating the dimensions of the setting using Super Duty Brick, let X be the distance from the floor to the shell. Then since the grate is 2 feet above the floor, the distance from the top of the grate to the bottom of the shell is X-2.

Furnace Volume =

$6 \times 9 (X - 2) = 54 (X - 2)$.

Vol. of Combustion Chamber =

$$\frac{6 \times 9\frac{1}{2}}{3} \times X = 198$$

From the above we find that with X = 6.5, the volume works out to 367 cu ft, which is about right for super duty brick. In calculating the dimensions for No. 1 fire brick we find that letting X = 9 will work out to 549 cu ft furnace volume, and this is satisfactory.

Thus, to give the same safety factor under similar operating conditions the No. 1 fire brick setting should be 2'-6" higher from the floor to the bottom of the shell than the super duty setting.

For the example as given 700 fire brick will be required per foot of height in the mid section, or an additional installation of 1,750 No. 1 fire brick over Super Duty.

A 9'-0" height to the shell calls for 7,450 fire brick

7,450 No. 1 fire brick @ $86.00/M.....	$640.00
Air setting High Temp. Mortar @ $95.00/T	123.50
	$763.50

A 6' x 6" height to the shell calls for 5,700 fire brick

5,700 Super Duty brick @ $106.00/M	$604.00
Air setting High Temp. Mortar @ $95.00/T	95.00
	$699.00
Saving using Super Duty (brick alone)	$64.50
Saving in labor 1-forman, 1-mason, 3-helpers 1200 F.B./day	97.00
Total saving using Super Duty fire brick	$161.50

Air Supply

Air required to burn 1,638 lb shavings per hr (from Table 2) at 40% excess will weigh 8.51 pounds per pound of shavings.

$1{,}638 \times 8.51 = 14{,}000$ lb air per hour.

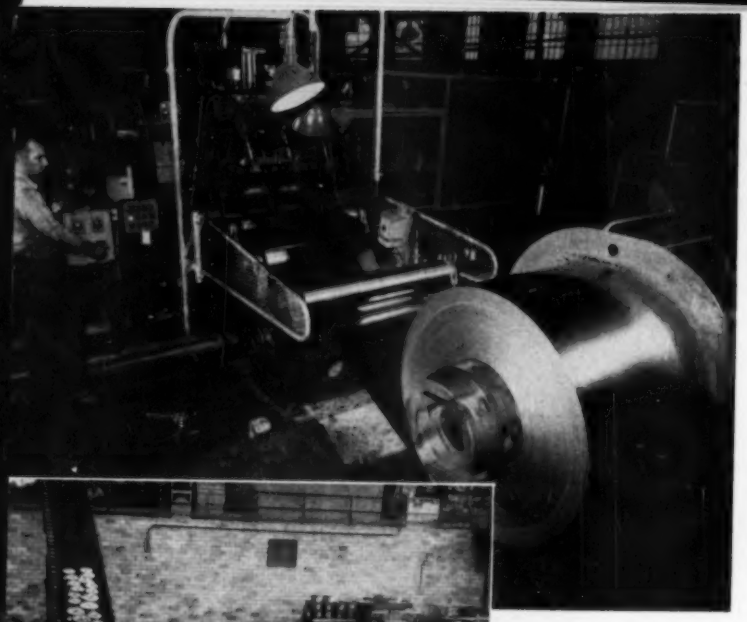
From Table No. 3, air at 140 F occupies 15.1 cu ft per pound.

$14{,}000 \times 15.1 = 210{,}500$ cu ft per hr or 3,500 cu ft per minute.

One half of this air should enter the furnace over the fire or 1,700 cu ft. If all of it entered the furnace over the fire the grates would burn out. With a furnace 9'-0" deep there will be 20 openings over the fire, each opening having an effective area of 9.9 sq in or a total of 198 sq in which is equivalent to the area of 2'-11" pipes.

ELECTRICITY at Work IN INDUSTRY

Photos by Westinghouse



LEFT: The entry end of a modern, high-speed, side-trimming line where steel strip is trimmed prior to tinplating. A photoelectric edge regulator, which can be seen at the right of the strip between the first two idler rolls, provides intelligence that shifts the entire pay-off reel assembly so that the edge of the strip is maintained at the same relative entry position.

LEFT: Conveying returned shipping spools to balcony area at Westinghouse copper wire mill. Returned spools are unloaded from trailer trucks at right onto the roller conveyor, where gravity carries them to the power-driven, belt conveyor that transports them to the balcony.

BELOW: Piling paperboard "high and deep" with overhead travelling crane. Recent developments in a-c crane control aid the careful handling necessary for this type of load. Electrical retardation, with reduced maintenance, is replacing mechanical brakes for this type of service.

BELOW: These grain bins are filled and emptied by remote control. The level of grain in each bin is indicated on the remote control board. The chute at bottom is opened by the motor-operated mechanism, and grain is pneumatically conveyed through the pipe as needed.

Modern Trends In

Industrial Power Distribution

By D. H. McIntosh

Substation Section, Allis-Chalmers Mfg. Co.

IT is interesting and even somewhat amusing to see electric power equipment catalogs from the early 1900 period boasting of their open type oil circuit breakers. Doubtless it will be at least equally interesting and amusing for engineers in the year 2000 to look backward to what we have done.

This article discusses modern trends in industrial distribution and substantiates reasons for some of the major ones. These trends include:

1. General adoption of the load center principle of distribution some fifteen years ago and its wide spread use throughout all industry.
2. Higher voltages.
3. Planned distribution systems that allow for expansion and are properly protected.
4. Use of standardized distribution equipment.

Load Center Principle

It hardly seems necessary to draw attention to the very pronounced trend toward the load center principle of distribution. This simple principle of carrying the high voltage closer to the load is the most important single advancement in power distribution in recent years.

The load center principle has the following advantages:

1. Shorter runs of heavy and expensive secondary cable
2. Lower line losses
3. Improved voltage regulation
4. Greater dependability
5. Greater interchangeability of transformers or entire substations
6. Greater flexibility
7. Greater expandability

Fig. 1 illustrates the difference between the load center principle and the conventional type of distribution.

Distribution Voltages

In laying out a new industrial distribution system or adding capacity to an existing one, first consideration must be given to the total connected motor load, since this makes up the "lions share" of the total load for the average industrial plant.

In addition the plant engineer must take advantage of standard ratings of transformers and of metal-clad switchgear. The natural objective should be to select a distribution voltage near the top of one or the other of the two available classes of metal-clad switchgear, 5 kv or 15 kv. At the same time the voltage selected must allow sufficient margin to prevent overvoltage on the switchgear due to poor regulation. A higher voltage permits economical usage of switchgear with fewer feeder positions required and with greater expandability. Standard industrial distribution voltages include, 2400, 4160, 4800, 7200, 12,000, 13,200. The two most common distribution voltages found in industrial plants today are 2400 and 4160 volts.

In a system using large motors, the choice of 2400 volts would appear to be less expensive than 4160 volts as is shown in Fig. 2. Curve A (440 volts) includes the cost of the motor, a magnetic drawout circuit breaker, cable, and of transformation. The transformation cost is computed on the basis of the most economical size indoor type substation (750 kva at 440 volts). Curves B and C include cost of motors, fused air contactor full voltage type starters and cable. In all cases an arbitrary length of 150 feet of cable was assumed. The motors are squirrel cage induction type. The cost of the primary switchgear is not included in this comparison.

Four thousand volt motors in the large sizes range from 10% to 18% higher in cost than 2300 volt motors. Also the cost of high interrupting capacity fused air contactor starters are over 10% more expensive at 4000 volts than 2300 volts.

Despite this, 4160 volt distribution is more economical in most cases.

Metal-clad switchgear is less expensive at 4160 volts. One feeder position will carry 1.73 times as much current at 4160 volts compared to 2400 volts. In other words, for the same load more feeder positions are required for 2400 volts. The cost per circuit at 150,000 kva and above is actually less expensive at 4160 volts than at 2400 volts.

The economic limit of inter-

Presented at the National Power Conference held under the auspices of A.I.E.E.

TABLE 1.

Unit Substation Transformers Built in 1949 (By A-C)

Kva	150	200	300	500	750	1000	1500	2000
Percent Total Built	1.2	1.7	11.3	13.8	20.8	29.2	18.9	3.1

rupting capacity in circuit breakers at 2400 volts is 150,000 kva compared to 250,000 kva at 4160 volts. The ultimate load for a standard 1200 ampere bus is approximately 8600 kva at 4160 volts compared to only 5000 kva at 2400 volts. Obviously, for the same load 4160 volts provides more room for growth than 2400 volts.

It is to be recognized, however, that there are instances where 2400 volts has proved more economical especially where there are heavy concentrations of large motors.

In plants over approximately 8600 kva load, it becomes desirable to consider a distribution voltage above the 5 kv class. Many of the same factors that showed the advantage of the higher of two voltages within the 5 kv class apply in the comparison between 13,200 volts and a lower voltage.

In industrial plants of from 10,000 to 20,000 kva the large motors are sometimes operated at plant distribution voltage level. However, in many cases transformation is made from 13,200 to 2400 or 4160 volts for the large motors with a separate transformation to 480 volts for the motors of less than 200 horsepower. From the design standpoint, 13,200 volt motors are not desirable below 1000 horsepower.

Distribution Systems

What size unit substations are in common use in industrial distribution systems today? See Table 1.

Frequently, maximum economy is found in using several substations of the same size rather than several sizes within the same plant. In many cases the plant engineer is required to deviate from the ideal, in order to keep the cost of the electrical distribution system within a budget. Minimum total cost is always a major factor in the shaping of a distribution system.

The advent of the unit substation has caused the user to think more in terms of symmetrical distribution arrangements because of the natural symmetry introduced by unit substations. The plant engineer today is more single line diagram conscious than ever before.

The manufacturing process is another important consideration in the type of distribution system chosen. For example, it is standard practice today to separate welding loads from lighting loads to reduce flickering. The same is true for motors which cause frequent heavy load swings. The trend in all cases is to try to correct voltage swings at the source if feasible, and to correct bad power factor at its source. Series and shunt capacitors in the case of welders and small motors are in common use in industry today.

Experience over the past fifteen years has evolved definite distribution arrangements. Today the planning engineer has three basic primary connection schemes and four basic secondary arrangements. With these seven variations, it is possible to develop combinations which best suit the requirements of almost any manufacturing process.

The three basic primary arrangements are the (1) radial, (2) loop and (3) selective. The degree of continuity of service and the

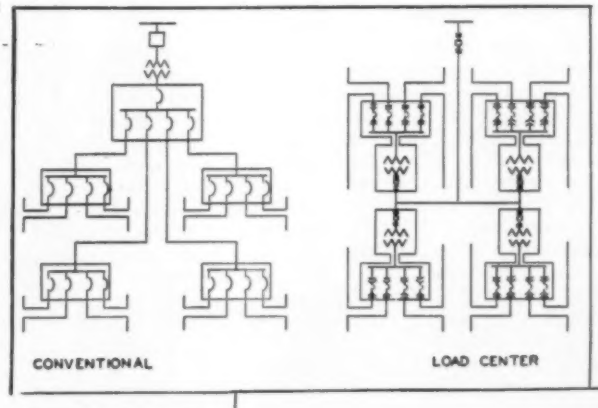


FIGURE 1—COMPARISON OF TYPES OF POWER DISTRIBUTION.

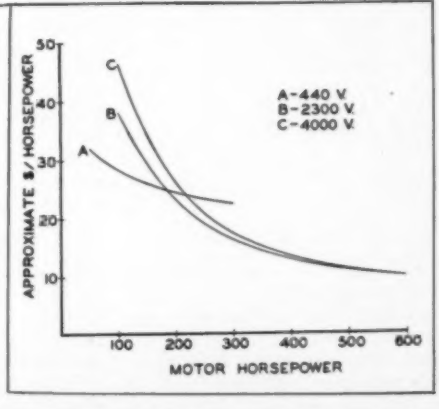


FIGURE 2 — APPROXIMATE EQUIPMENT COST EXCLUSIVE OF PRIMARY SWITCHGEAR.

cost are usually in the same order as the arrangements are listed, the radial being the least expensive. Fig. 3 illustrates the three basic primary arrangements.

The four basic secondary arrangements are the (1) radial, (2) low voltage selective, (3) spot network, and (4) the network. There is a unit substation for each secondary arrangement. Again, the degree of continuity of service and the cost are listed in order of increasing magnitude. The network type systems find very little use in industrial plants. Radial primary and radial secondary arrangements cover the majority of situations. Fig. 4 illustrates the four basic secondary arrangements. Fig. 5 illustrates how the "primary loop" and "secondary radial", for example, are put together into a workable distribution scheme.

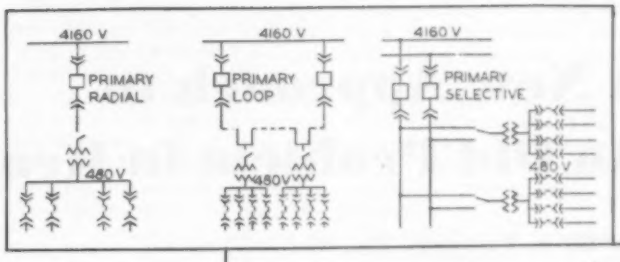


FIGURE 3—BASIC PRIMARY ARRANGEMENTS.

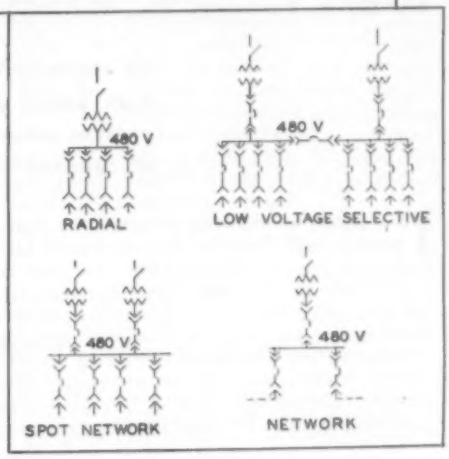


FIGURE 4—BASIC SECONDARY ARRANGEMENTS.

Standarized Equipment

Today there are four types of unit substation transformers—(1) oil filled; (2) askarel liquid filled; (3) indoor dry type; (4) outdoor dry type. The oil filled transformer is used for outdoor locations almost exclusively. Askarel liquid filled and indoor dry type transformers are both used for indoor applications. There are, of course, very definite applications for each type. Recent trends show an increasing use of the indoor dry type compared with the askarel liquid filled.

The outdoor dry type is a new member of the transformer family. The application which introduced the outdoor dry type transformer was the expansion of a large industrial distribution system where space was at a premium and it was necessary to locate the units on the factory roof.

There has been increasing interest by industrial users in the noise problem. This is significant when it is realized that the noise level is usually high in most factories. For example, there seems to be a tendency by some industrial concerns to give more attention to transformer noise than the transformer losses, some sacrifice in efficiency being necessary to reduce noise. This same interest in noise reduction is also applied to other apparatus.

The trend away from open type switchgear in industrial plants has been very pronounced. Today more than 95 per cent of the switchgear called for in industrial installations is metal-clad.

Impulse strength of industrial electrical equipment in recent months has received more attention than ever before, because of the accelerated use of air insulated equipment.

Air insulated equipment has an inherent lower impulse strength than oil immersed equipment. More and more, magnetic air circuit breakers, dry type transformers, contractors, large motors, and generators are being surge protected at the higher distribution voltages with outdoor installations getting particular attention due to more direct lighting stress.

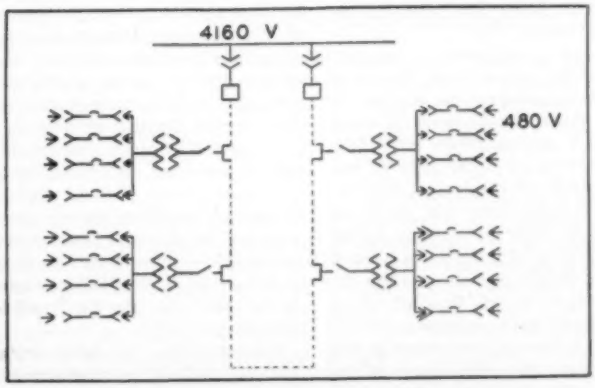


FIGURE 5—PRIMARY LOOP WITH RADIAL SECONDARY.

A New Approach to An Old Problem in Heat Balance

By R. A. Cooper, Jr., Application Engineer, Calmes Engineering Co., New Orleans, Louisiana

An engineer tells how he selected equipment to supply both power and steam to one industry. Other plants present other problems, but the approach and manner of solution is typical of careful engineering analysis.

IN a joint modernization program, the Valite Corporation and Valentine Sugars, Inc. of Lockport, Louisiana, have installed the first of several gas engine driven electric generators. Unit consisted of a 438 kva, 480 v alternator, a 505 hp Cooper-Bessemer spark ignited gas engine and affiliated switchgear.

Although the installation is entirely conventional, certain fundamentals can be emphasized that will prove of interest and value to operators engaged in providing power and steam for process industries.

Sugar, plastics, paper, naval stores, chemical and other comparable processes employ electrical and/or mechanical energy in combination with large volumes of heat direct to process.

Many of these processes have been wedded almost inalternably to the exclusive use of steam as the source or medium of both power and heat. Consequently, this discussion is of particular significance. After a careful engineering survey, Valite-Valentine selected an internal combustion engine.

THE position of the majority in their choice of an all steam process is by no means the outgrowth of any idle prejudice, since it has been conclusively demonstrated that steam is, in the great majority of cases, the most practical if not the only logical media for the range and scale of heating involved in industrial operation.

It's entirely logical, since steam must be generated for heating, to utilize it for the power required in the cycle. This was particularly true in the early development of these processes when steam machinery was practically the universal source of power, but there are many factors that effectively support it's continued employment —the subsequent development of many and varied forms of prime movers notwithstanding.

Primary among these factors is the inherent fact that the average non-condensing steam engine converts considerably less than ten per cent of the total heat available at the throttle to mechanical energy. This means that generally upwards of eighty per cent of the initial steam heat value is available in the engine exhaust for heating, a ratio that closely approximates the average process requirements. The pressures for which heating apparatus generally can be most economically designed to provide the temperatures and heat transfer commonly required dictate the use of low pressure steam such as engine exhaust. It is logical that the practice became, and to a large extent remains, to impose the power machinery between the steam generators and the heating apparatus of the cycle so that the engines served the dual function of prime mover and pressure reducing device.

As the most effective illustration of the merit of this logic and at the same time to expose its most inherent weakness it must be kept in mind that while the overall thermal efficiency of the average non-condensing steam engine is materially less than ten per cent when exhausting to the atmosphere, efficiency can be well above ninety per cent when exhausting to a cycle that can utilize the total heat available in the exhaust. This is true since in the latter case the only losses in the generation of power would be those of friction and radiation, and these, particularly in the case of a turbine, are practically negligible. There are of course boiler losses that must be taken into account, and generally it is doubtful if, at the temperatures and pressures economically permissible, boiler efficiencies of even eighty per cent can be maintained. Thus if we allow a cycle efficiency, exclusive of the boilers, of seventy per cent, which can be and is often realized in some processes, our overall plant efficiency would be .70x.80, or fifty-six per cent. The significance of this is apparent when it is realized that the most modern of our central station power plants realize only a little over thirty per cent overall thermal efficiency.

To establish more clearly this line of reasoning, and particularly it's relation to our subject, it should be remembered that at any pressure and temperature many times as much heat is necessary to flash or evaporate a liquid into vapor as is required to raise the liquid to that temperature.

For example, to raise water from 32F to 212F requires approximately 180.7 Btu. To evaporate

this water from the liquid at 212 F to steam, still at 212 F requires an additional 970.3 Btu.

Conversely, and what we are almost more concerned with here, if we receive steam to the heating apparatus of a process, and do not condense the steam to water in the operation, then we are realizing only a very minor fraction of the heat that we spent good money to impart to that steam in the boilers.

Again by way of illustration, negative guage pressure of 10 psi steam is only the medium for the transfer of heat, and steam at a (4.7 psia) with an enthalpy of about 1130 Btu/lb would retain, leaving the apparatus, 1002.5 Btu/lb over the heat content of the saturated liquid at the same temperature. Adjusting the rate of transfer or the supply of steam so that condensation is effected in the apparatus, still at the same temperature, would reduce the losses from 1130 to 127 Btu/lb.

It is entirely impractical in many cases to attempt to regulate an entire process in all of it's stages to the degeree that the heating steam can be completely condensed in each and every piece of apparatus. However, the desirability of arranging and controlling any process heating cycle so that on an overall basis, at least a significant per centage of the steam is usefully condensed is obvious. Our principal concern is, in fact not with the efficiency of the heating phase of the cycle, but with factors in the power phase that can and do limit and control this efficiency.

Ratio of Power To Heat

To this end we can assume, hyopthetically, that we have a heating phase in our cycle that, when supplied with the precise heat required, can utilize this heat 100 per cent. It might be well to reread this last sentence and emphasize heavily the phrase: *The Precise Heat Required.*

Up to this point we have touched but lightly on the ratio of power to heat required at any given instant, and what is more important, the stability of this ratio in the course of normal operation. We can now credit an all steam plant (assuming our hypothetically perfect heating cycle) 80 per cent efficient boilers, and (allowing five per cent friction and radiation losses in the machinery) with an overall efficiency of .80x.95 or seventy-six per cent. This 86 per cent can only be attained however providing the exhaust from the steam machinery contains at all times the precise heat required to the heating phase. To even remotely approach this condition in practice will require two things which in any event will be difficult and costly and in many cases flatly impossible with the simple cycle that we have described.

In the first place, to closely approach such high efficiency we will have to have our cycle so closely designed that at any selected set of conditions the ratio of power and heating required to process would provide in the engine exhaust this precise heating requirement. For economic considerations there is a specific mechanical requirement just as there is a definite heat demand and this factor alone will suffice in many instances within our simple cycle to completely disrupt the desired balance.

Even if this ratio can be reasonably realized we have a second and equally important requisite that this selected ratio of power to heat be maintained ridgidly constant throughout the flucuations that are normal to any such operation. That this can be completely realized in any process is at least highly improbable.

Electrification

The great majority of operators

The Valite-Valentine Application

In this application, boiler capacity was ample and the initial cost of a condensing steam turbine would have been well below that of the gas engine. To understand the selection of the more costly unit, we can very briefly construct the cycle with a condensing steam unit and then make a simple direct comparison.

We begin with water at a temperature of 80 F with an enthalpy (heat content) of about 48 Btu/lb. This water is to be converted to steam at 150 psi O F superheat with an enthalpy of approximately 1195.5 Btu/lb.

The conversion is to be effected in a boiler with an efficiency of of about 80 per cent, which means that something around 1420 Btu in fuel will be required per lb of steam.

Neglecting losses in delivering steam to the turbine, and assuming as a reasonable condition that the turbine would exhaust into a vacuum of 27-in. Hg, we have available through the turbine about 90 Btu/lb. Allowing the turbine an engine efficiency of 95 per cent, this will result in a water rate of approxiamtely 26 lb/bhp/hr and hence, with boiler losses, a thermal efficiency of something less than 6.9 per cent.

The internal combustion engine has a fuel requirement of about 9500 Btu/bhp/hr, which is equivalent to a thermal efficiency of around 26.8 per cent, very nearly four times that of the steam unit in this particular application .

To compare the two units in actual dollars and cents, we can assume a load factor of 75 per cent, or roughly 2,300,000 kwh per year. Selecting the factors at variance in the two units we have initial cost, fuel and lubricant consumption, and maintenance.

With fuel gas at ten cents per thousand cu ft, lube oil at fifty cents per gallon, depreciation over a twenty year period, and maintenance at $3.00 per hp/hr on the engine against $2.00 hp/hr for the turbine (including boilers), we arrive at the following forecast of an average yearly cost differential:

Steam Turbine	$16,050.60
Gas Engine	7,500.00
Difference	$ 8,550.00

This indicates conclusively that, in this case, the internal combustion engine is the logical choice. It does not mean, nor is it intended to imply, that the internal combustion engine will in every case so exceed the performance of the steam turbine. It should demonstrate that mere availability of boilers is not a sufficient reason to eliminate internal combustion engines from due consideration as prime movers.

have long been aware of these requisites, and most have taken a very simple and admittedly effective step to at least remedy the situation. This solution incidentally evolved indirectly out of the enforced realization of the tremendous advantages of electric motors and transmission systems over steam engines and piping, particularly in locations remote from the boilers. The electrical installation costs less initially, costs but a fraction as much to maintain, and is infinitely more efficient; a combination that can hardly be ignored.

On this basis, in the case of new plants, the obvious answer is to provide for at least a major part of the power requirement in a centrally located turbo-alternator exhausting to the heating phase of the cycle. In the case of existing plants, since factories are not rebuilt overnight, the electrification must be more gradual, beginning with the conversion of the more remote secondary machines, and being largely confined to replacements required in the case of primary machinery.

The substitution of modern turbo-alternators and mechanical drive turbines with efficiencies well above older type engines can be, and has in many cases deliberately been carried to the extent that the exhaust steam becomes inadequate for the heating requirement when the latter approaches peak. This neccessitates or permits, as the case may be, the installation of a pressure reducing valve supplying the additional heat required direct from the boilers to the heating phase of the cycle.

In the case of new plants the cycle could of course be designed around the use of the pressure reducing valve with the turbine exhausts well short of peak heating requirements.

Disadvantages

Since this arangement tends to prevent an oversupply of steam to the heating phase it may be the ideal solution in certain processes. There are, however, three major drawbacks. In the case of existing plants, it is predicated on the extensive and costly replacement of perfectly serviceable equipment with new units which have the sole advantage of a reduced water rate. In the case of new plants this could well mean the selection of considerably more expensive machines than would otherwise be required. Secondly, the corrective or controlling effect is definitely limited and imposes very rigid restrictions on the mechanical or power phase of the cycle. Finally, steam passing through a reducing valve naturally acquires a degree of superheat equivelent to the pressure drop, which means simply that, while controlling the quantity, the quality of the heating steam is being varied, and in many operations fluctuations in quality are as much and often more undesirable than quantity variation. The ideal application of the pressure reducing valve is to control the quality of the heating steam.

If we are to achieve optimum results, we must in some way contrive to generate steam to the exclusive and exact requirements of the heating phase of our cycle. However, this steam generated to meet heating requirement is also a potential source of power that can be realized at about one half of the cost of power from any other known source.

As has been stated, our problem lies in the fact that in the majority of processes the power and heat demand unfortunately do not always fluctuate in unison and much too frequently we find our power demand at peak with the demand to heating materially below average, or vice versa. This means that, instead of realizing power at an efficiency of well over fifty per cent, we can conceivably drop to a figure below five per cent--in short from the sublime to the ridiculous.

To control this condition, we are practically forced to the concession that the only solution is through a supplementary source of power, a source completely independent of, and isolated from the heat phase of the cycle. Local circumstances will govern whether this power can most economically be purchased or generated. In this treatment, we will assume that the supplementary power can most economically be generated.

The generation of power inde-

Southern States Equip. Corp. Anniversary

Southern States Equipment Corporation of **Hampton, Georgia,** recently celebrated its 34th anniversary and its 19th as a Georgia industry at a dinner in Atlanta, Georgia. Meeting was reported in the January issue of SP&I.

At the SSEC banquet (left to right) are **Thomas E. Curtis,** chief engineer electrical division, SSEC; **J. F. Pennington,** operating manager, Georgia Power Company; **Olan Richardson,** president, SSEC; **J. M. Oliver,** vice-president, Georgia Power Company; and **Thomas A. Burdeshaw,** sales manager, electrical division, SSEC.

The electrical division of Southern States Equipment Corporation sells its products (high voltage electrical equipment) on a nationwide scale to the utility industry, and is the third largest independent manufacturer in its field.

The mechanical division of the company manufactures textile machine specialties and replacement parts for textile machinery.

pendent of the heating phase presents us with a choice of two prime movers, condensing steam, turbines or internal combustion engines. The size or capacity of these units will be governed by two factors. First, the maximum degree of unbalance that can be expected in normal operation; and second, the power that will be required during those periods when the heating phase of the cycle is inoperative.

This means the duplication of a predetermined percentage of the non-condensing horsepower with independent power. Then the non-condensing engines can operate to match the heating phase of the cycle, and any resultant shortage in power comes from the independent source. Such operation can be made entirely automatic by the simple expedient of paralleling the two power sources electrically and without one additional control feature above those necessary to normal operation. The simple execution of this principle is predicated on a minimum requisite in electrification.

The question of condensing steam turbine versus internal combustion engine is somewhat complex and will vary materially with the individual case. Generally speaking, while it would appear that where there is sufficient boiler capacity, the odds would overwhelmingly favor the steam unit, does not always prove out in a complete analysis, particularly in cases where gas is used for fuel. To offset its higher initial cost, which would be the case if additional boilers were not required, the internal combustion engine affords a considerable simplification of overall plant control and a greater degree of control, since, like purchased power, it is completely divorced from the boilers while the steam unit is not.

A far more accurate criteria will be the steam pressure and degree of superheat. In plants with pressures of 750 psi and higher and with superheat at 400F and above the turbine rapidly comes into it's own. In plants operating with steam pressures in the 200 psi range and with little or no superheat the internal combustion engine has an advantage. Another factor of considerable weight will again be that of the load during periods when the heat phase is inoperative and the relative duration of such periods. An appreciable load of any duration during these periods will prove advantageous to the internal combustion engine.

Launching a Tunnel

Consolidated Western Steel at Orange, Texas, produces steel sections for 2550 ft tunnel.

A new and unique type of launching was recently witnessed on the end-launching ways of U. S. Steel's Consolidated Western Steel Corporation at Orange, Texas. The first fabricated steel section of a new vehicular tunnel being built for the Texas Highway Department left the ways and slid into the water preparatory to its trip to the Houston Ship Channel. Here it will form part of the new highway system linking Baytown with LaPorte, Texas.

The tunnel, when completed, will form a concrete-lined tube about 2550 ft long. It will consist of nine cylindrical sections of half-inch steel plate about 35 ft in diameter. Six of the sections are 300 ft long and three are 250 ft long.

Because of the arrangement and condition of Consolidated Western's yard facilities, the tube sections are end launched. This imposes critical compressive longitudinal stresses in the upper shell. So, to prevent buckling, two I-beam stiffeners are tacked along the top outer surface, crossing the point of maximum bending moment.

In preparing for launching, the weight of the tube is transferred to timber cradles set on continuous sliding ways. Standard "wedging up" procedure of typical ship launchings is employed. The tube section is released by burning through sole plates on each sliding way.

About 75 tons of reinforcing steel are placed in the bottom of each tube before launching to serve as ballast. The tube, when afloat, draws between 4 and 4½ feet of water.

Because of the large square dam plates at both ends and saddles and other projections on the bottom of the tube, the cradles and sliding ways cannot be withdrawn as a complete unit after launching. It was necessary to devise a method to pull out the cradles and sliding way from each side of the tube. To eliminate the use of divers, crossed wire cables were used to tie the starboard sliding way to the port side of the tube above water and vice versa. Loose timber spreaders were used to separate the sliding ways. This arrangement permitted side removal of port and starboard cradles and sliding ways as two separate units.

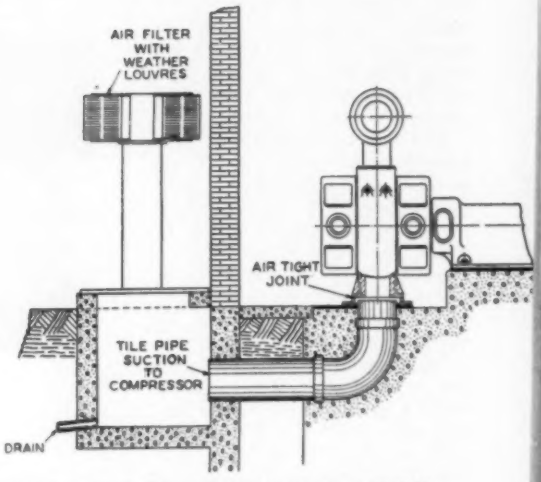
Your Compressed Air System

Good Maintenance Assures Three Way Savings

★ **Longer life for compressor**

★ **Prevention of power loss**

★ **Greater productivity of tools at point of use**



FILTER ATTACHED TO INTAKE PIPE ELIMINATES DUST OR FOREIGN MATTER AND PREVENTS RAPID WEAR OF WORKING PARTS.

DETAILS of any maintenance plan must be worked out according to the conditions of the particular industry and the size of its operations. However, the basic steps in any plan are much the same.

Regular inspection should be made of the compressor plant at definite intervals. This would include replacement of worn parts, new packing, adjusting for wear of working parts and cleaning of air valves and crankcase.

This regular inspection also will reveal whether or not there is a need for other corrections. For instance, the presence of any deposit on the valves usually indicates either that the intake air is dirty or that too much oil, or unsuitable oil, is being used.

All ports and passages should be examined and any obstruction such as carbon and sticky oil removed. Water jackets should be inspected and cleaned out as frequently as water conditions may require. Oil used in the crankcase of a reciprocating compressor must be changed at intervals. In doing so, the crankcase should be thoroughly cleaned. It is inadvisable to use waste for wiping, or any other material which might leave lint to obstruct oil passages. Gasoline or other inflammable liquid should never be used for washing.

Recommendations of the air compressor manufacturer's engineer at the time of the installation and afterwards can be of great assistance in determining the frequency of inspection. Once the frequency has been established, the important thing is to hold to the regular schedule since the idea is to avoid trouble rather than to repair it. This policy not only

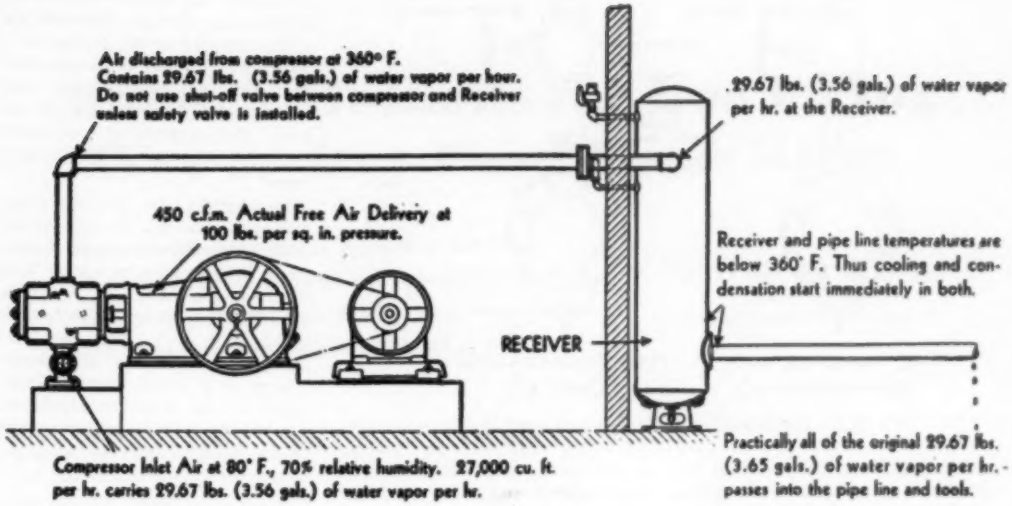
DATA AND ILLUSTRATIONS COURTESY COMPRESSED AIR AND GAS INSTITUTE.

Watch That Leakage

Of the several sources of power, none is so conveniently stored and conveyed to the point of use as compressed air. It requires no insulation against heat loss in transmission and involves neither fire nor shock hazard. It is these very desirable characteristics, however, which are largely responsible for a common oversight in maintenance practice, which is checking to keep air lines tight to avoid leaks. The oversight is costly even though not unsafe.

Taking 6 cents per 100 cubic feet as the cost of air, a leak with an opening as small as 1/16-inch will lose $10.94 a month and a ¼-inch leak would lose $175.25. Obviously, **a few small leaks can add up to a considerable dollar loss.** If the leaks also are responsible for pressure drop at the point of work, the dollar loss in lowered productivity of high hourly rate workmen using pneumatic tools can amount to far more than the direct loss from air leaks.

In checking leaks, particular attention should be given at blow guns and also to those air connections which are more or less out of sight. An air leakage test should be run on the entire plant. Elimination of leakage involves making the system tight and then keeping it tight. Regular inspection is mandatory. There are a number of well known, simple ways to check on leaks. One is to introduce wintergreen in the system and follow the nose to the leaks.


Air discharged from compressor at 360° F.
Contains 29.67 lbs. (3.56 gals.) of water vapor per hour.
Do not use shut-off valve between compressor and Receiver unless safety valve is installed.
.29.67 lbs. (3.56 gals.) of water vapor per hr. at the Receiver.
450 c.f.m. Actual Free Air Delivery at 100 lbs. per sq. in. pressure.
Receiver and pipe line temperatures are below 360° F. Thus cooling and condensation start immediately in both.
RECEIVER
Practically all of the original 29.67 lbs. (3.65 gals.) of water vapor per hr. passes into the pipe line and tools.
Compressor Inlet Air at 80° F., 70% relative humidity. 27,000 cu. ft. per hr. carries 29.67 lbs. (3.56 gals.) of water vapor per hr.

COMPRESSOR ARRANGEMENT SHOWING PIPING TO RECEIVER WITHOUT AFTERCOOLER.

maintains the compressor at full efficiency and prolongs its life, but prevents impairment of the efficiency of the operating departments where compressed air is the power used in their work.

Lubrication

The types of oil best suited for compressor cylinder lubrication depend upon such factors as the kind of gas compressed, ratio of initial and final pressures developed within the cylinder, number of stages of compression, type of cooling (air or water for example), and other factors. Also a compressor may require as many as three types of oil; one for the compressor cylinder, another for crankcase and bearings, and a third for the power cylinders. For compressors of the single acting type, the oil must be suitable for both cylinder and crankcase lubrication while the double-acting type requires compressor cylinder lubrication and crankcase oil for running gear.

In view of these varying requirements, it is understandable why no general rule may be given for compressor lubrication, unless that rule were simply to be sure that proper lubrication methods are followed. All reputable oil companies have developed lubricants suitable for varying oper-

◆

BY COOLING THE AIR TO APPROXIMATELY THE SAME TEMPERATURE AT WHICH IT ENTERED THE COMPRESSOR, AN AFTERCOOLER CONDENSES MOST OF THE VAPOR AND SEPARATES IT OUT OF THE AIR BEFORE IT ENTERS THE SERVICE LINES WHERE OTHERWISE IT WOULD CONDENSE. WATER IN A COMPRESSED AIR SYSTEM USUALLY RESULTS IN HIGH MAINTENANCE COST IN SEVERAL WAYS AND REDUCES TOOL EFFICIENCY.

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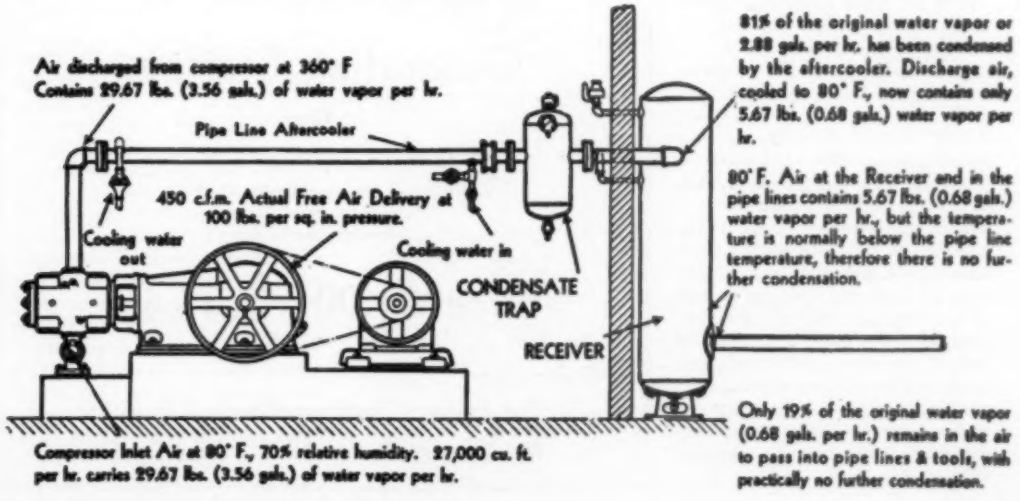
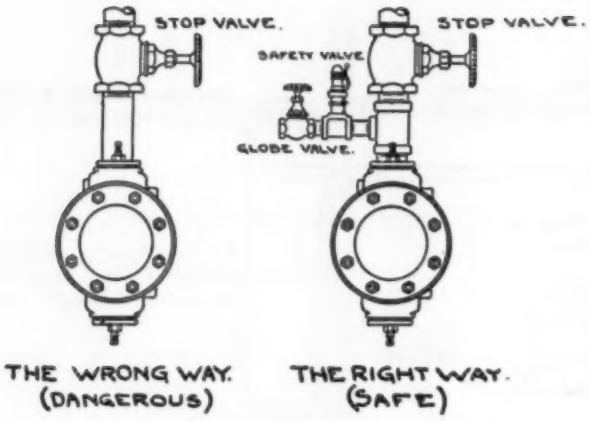
COMPRESSOR ARRANGEMENT SHOWING PIPING TO RECEIVER WITH AFTERCOOLER.


Air discharged from compressor at 360° F
Contains 29.67 lbs. (3.56 gals.) of water vapor per hr.
Pipe Line Aftercooler
81% of the original water vapor or 2.88 gals. per hr. has been condensed by the aftercooler. Discharge air, cooled to 80° F., now contains only 5.67 lbs. (0.68 gals.) water vapor per hr.
450 c.f.m. Actual Free Air Delivery at 100 lbs. per sq. in. pressure.
Cooling water out
Cooling water in
CONDENSATE TRAP
80° F. Air at the Receiver and in the pipe lines contains 5.67 lbs. (0.68 gals.) water vapor per hr., but the temperature is normally below the pipe line temperature, therefore there is no further condensation.
RECEIVER
Only 19% of the original water vapor (0.68 gals. per hr.) remains in the air to pass into pipe lines & tools, with practically no further condensation.
Compressor Inlet Air at 80° F., 70% relative humidity. 27,000 cu. ft. per hr. carries 29.67 lbs. (3.56 gals.) of water vapor per hr.



RIGHT AND WRONG WAY TO INSTALL SAFETY VALVE.

ating conditions. They market the products under their trade names and are prepared to assume responsibility for the effectiveness of their lubricants for any particular service. This service coupled with recommendations of the compressor manufacturer will enable plant engineers to incorporate the proper lubricating methods. Regularity is the important consideration from that point on. Readers who desire a more detailed discussion of compressor lubrication are referred to "Compressed Air Handbook", which is published by Compressed Air and Gas Institute.

Hose Menders

The last link in the distribution system to the point of work is where trouble is frequently found. This is the use of hose menders. In such cases ¼-inch pipe usually is used in ½-inch hose. This makes a serious restrictor that will cut down the output of the tool to a market degree. A needle pressure tester inserted first at the end of the hose near the pipe and then beyond the mender, near the tool, will (while the tool is operating) quickly show how seriously pressure is reduced. It is not uncommon to thus reduce the efficiency of the tool by one half, and frequently more. Consider the hourly rate of the worker using the pneumatic tool for an idea of what such a repair method costs per day. Inferior hose which swells or disintegrates has much the same result.

A properly engineered distribution system has adequate sized pipe to prevent serious pressure drop, but the results of good planning are not realized if the air hose restricts pressure or if too long hose lengths are used in relation to their inside diameter. The situation requires a periodic checkup in connection with hose menders, lengths, nipples, quick-detachable couplings and additional tools.

Tools

Possibly a discussion of the compressed air system should stop at the point of work. However, the entire purpose of the system is to accomplish certain work effectively and economically and any maintenance program should include maintenance of pneumatic tools and other air-operated equipment.

Responsible men who are properly trained should be selected for portable tool maintenance. A constant maintenance program will insure replacement of bearings, etc., before damage is done. All pneumatic tool manufacturers provide maintenance and repair sheets as a guide. Service engineers of the tool manufacturers can be especially helpful in setting up an inexpensive but effective tool maintenance program.

From compressor to tool, compressed air is notable for the ease and economy of maintenance for the entire system. But the fact that the system will function without a good maintenance program does not mean that such a program is unnecessary to efficient operations. The key to a succesful program is regularity in carrying out a well considered plan. The cost for this regularity is small and the returns are surprisingly large.

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Modern Methods for Gas Firing Wet or Dry Feed Lime Kilns

Burners that facilitate accurate control of temperature throughout the kiln are needed to prevent reversal of the chemical reaction and formation of rings.

By William T. Rogers
Sales Engineer
Coppus Engineering Corporation

THE thermal dissociation, calcination or "burning" of calcium carbonate is a chemical process of considerable technical importance, not only in the case of the calcination of limestone or shells to lime but also in several important industrial processes. In the industrial operations the procedure is employed to recover calcium oxide by calcination of calcium carbonate (usually a spent product of the industrial process).

Problems

The chemistry of the process is very simple: $CaCO_3$ + Heat → CaO + CO_2. However, if the time and temperature elements associated with the "burning" of $CaCO_3$ to form CaO and CO_2 in the conventional rotary kiln are not closely governed, the process becomes a reversible one, so that with reduced temperature we may have: CaO + CO_2 — Heat → $CaCO_3$. Reversed reaction is undesirable since the causticity or "effectivety" of the made lime is materially reduced by such action.

Accordingly, it will be part of the aim of this article to bring out methods of escaping such a condition. In so doing the importance of effectively controlling the temperature-time variables will be pointed out as well as showing the benefits to be gained by the use of modern firing equipment especially adapted to this problem.

The trouble of "ringing-up", or the formation of a solid mortar ring in the kiln which impedes the natural flow of the kiln, is also a major problem and will be treated as such subsequently.

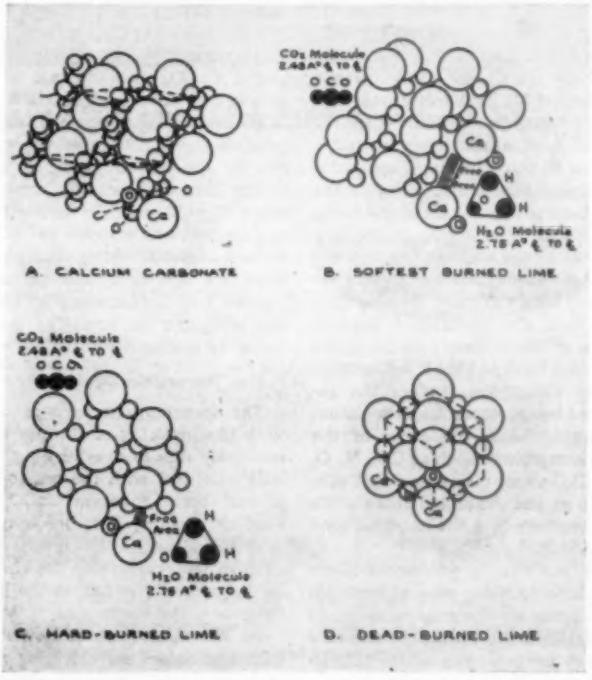
Another problem results from overfiring which produces "hard-burned" or "dead-burned" lime. Lumps of such lime show signs of shrinkage, cracks, are off color and slow up in reaction time. This shows that the internal free spaces in the CaO molecule have shrunk until the H_2O molecule physically cannot enter on hydration. This is shown clearly in the following discussion and illustrations.

Overburning

Fig. 1A. gives an enlarged view of the atomic structure of a lump of $CaCO_3$ with the Ca, C, and O atoms spaced as they occur in the $CaCO_3$ molecule.

Fig. 1B. shows the structure of "soft-burned" lime and again with Ca, C, and O spaced, on an enlarged scale, as they occur in the CaO molecule. Along side the "free space" in the lump of CaO is a molecule of H_2O drawn to the same scale. This clearly shows that in soft burned lime the free spaces are large enough to accommodate H_2O molecules and thereby the rate of hydration will be accelerated so

FIG. 1. ENLARGED VIEWS OF ATOMIC STRUCTURE.



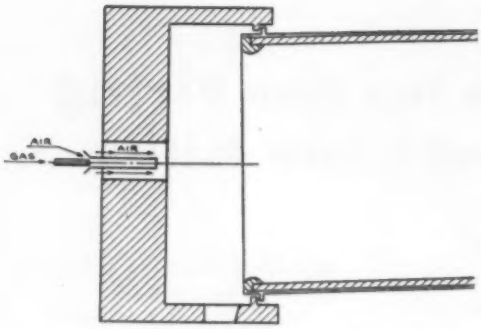


FIG. 2. EXAMPLE OF CONVENTIONAL BURNER.

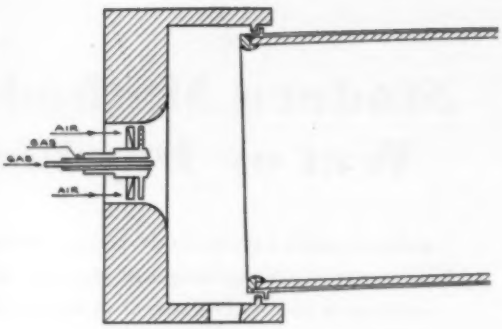


FIG. 3. MODERN DESIGN BURNER.

the causticity or "effectivety" of the lime is satisfactory. (Azbe describes this porous structure as "a city, with the buildings representing the CaO fixed in place and the streets and alleys as the passage-ways left by the CO_2 molecules dissociated from the lump of $CaCO_3$").

Fig. 1C. shows the structure of "hard-burned" lime with a molecule of H_2O along side the "free space" in the CaO. In this case it will be plainly seen that the free space is not large enough to accommodate the H_2O molecule so it follows that the rate of hydration will be greatly reduced and the effectivity of this lime unsatisfactory.

Fig. 1D. shows "dead-burned" lime which has no free space left between the Ca and O atoms thus it has lost all its effectiveness and is of no commercial value.

$CaCO_3$ at atmospheric pressure, begins to dissociate at a comparatively low temperature. That is, the CO_2 begins to pass out of the lump of $CaCO_3$. This action is initially limited to the surface. CO_2 concentration within the lump will be higher and will raise the dissociation rate. The dissociation temperature of the surface may be in the neighborhood of 1550 F but immediately under the surface the required temperature for dissociation is higher. Also the gases of the kiln atmosphere such as CO_2, N_2, O_2 and H_2O vapor may enter the $CaCo_3$ lump so that the actual dissociation temperature is in the neighborhood of 1650 F.

As the charge progresses down the kiln and the rate of heat input increases, the concentration of CO_2 within the lump will increase due to the retarding action of friction of the CO_2 molecules trying to escape through passage-ways in the lump left by CO_2 molecules already dissociated from the lump of $CaCO_3$. It is easy to reason that there can actually be "free" CO_2 in the center of the lump which is "motionless" awaiting its turn to leave the lump by a passage-way. Dust and slag also may partially block the outlet passage-ways to increase the retarding action of the CO_2 trying to escape the lump. Thus, CO_2 in the center of the lump will be exerting tremendous pressure outward in its effort to escape the lump.

If the charge is overburned, that is, a hard shell of CaO is formed to surround a lump of partially dissociated $CaCO_3$, the internal pressure of the contained CO_2 will force CO_2 out as near to the surface as possible through the passage-ways left by the already escaped CO_2. Under temperature and pressure this CO_2 will recarbonate the previously formed CaO back to $CaCO_3$. Thus we have the lump discharged from the kiln as a shell of hard-burned CaO surrounding a "core" of $CaCO_3$ and the causticity or effectivety is all but eliminated.

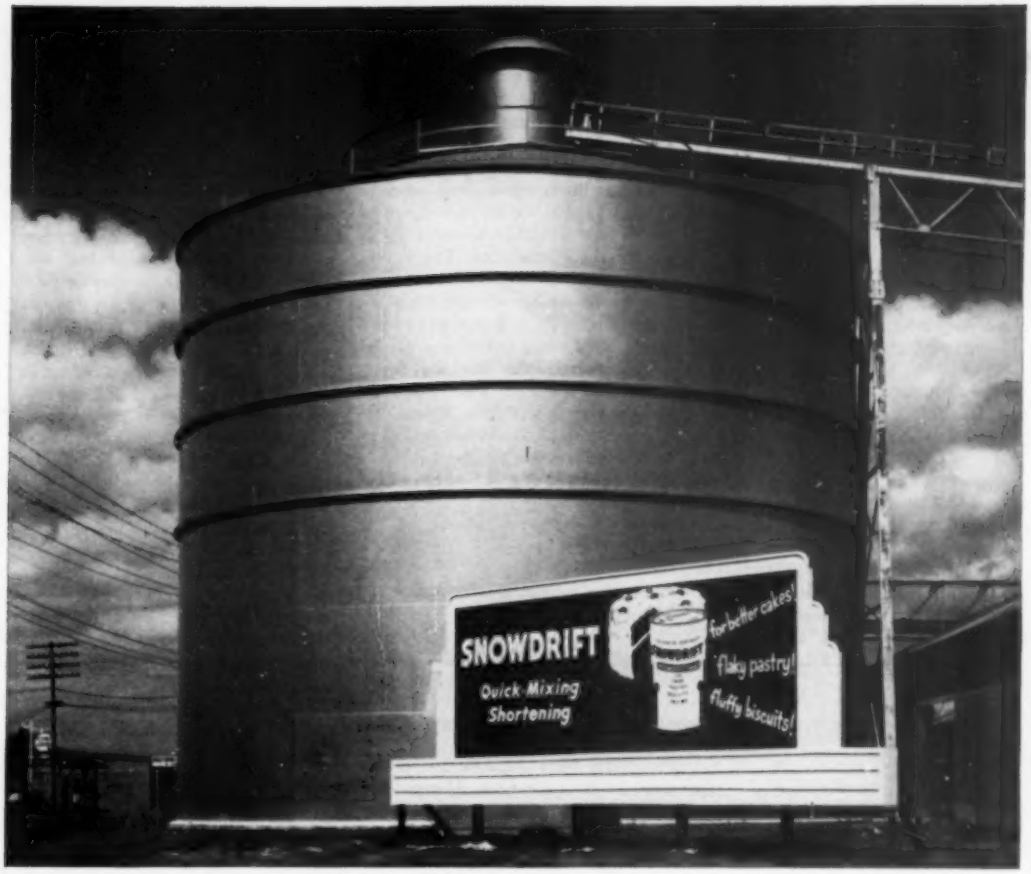
Reversible Equation

The foregoing paragraphs deal with the lowering of the per cent causticity due to overburning. We will now deal with the possibility of our basic equation $CaCO_3$ + heat → CaO + CO_2 becoming a reversible one as the result of a drop in temperature of the charge in the presence of CO_2 in the kiln, prior to being discharged.

As the charge moves down the kiln and enters the calcining zone or "hot spot", the $CaCO_3$ begins to liberate CO_2 and continues to do so until the dissociation is complete, of course assuming the charge is kept up to dissociation temperature yet not overburned as described above. Since CO_2 evolves from a lump of partially dissociated $CaCO_3$ for some time, it is entirely feasible that the complete dissociation of $CaCO_3$ to CaO will include a time interval during which the charge continues to move down the kiln to the discharge.

For dissociation to go to completion and not reverse, it is necessary for the temperature of dissociation to remain constant and also that one of the products be constantly removed or not allowed to increase in concentration. In the case of the thermal dissociation of $CaCO_3$ with the corresponding evolution of CO_2, it is necessary to keep the temperature of the charge in the kiln up to dissociation temperature right to the point of discharge from the kiln. This is easily reasoned because even though the draft of the kiln is constantly removing the CO_2, the charge constantly replaces this CO_2, and thereby the charge remains in a fairly concentrated atmosphere of CO_2. Under such conditions the basic equation immediately becomes reversible with a drop in temperature of the charge prior to its discharge into an atmosphere free of CO_2.

With this thought in mind, it follows that with the conventional type burners employed on kilns, that is, jet burners that give a high enough temperature to dissociate the $CaCO_3$, but which confine this temperature to a "hot spot" some 25′ to 40′ up into the kiln, it is



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Above: 60-ft. diam. by 50-ft. welded steel tank for storing soy beans at the Pensacola, Florida, plant of the Southern Cotton Oil Company.

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New York 6.....3212—165 Broadway Bldg.
Philadelphia 3.....1646—1700 Walnut St. Bldg.
Salt Lake City 4.....545 West 17th South St.
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possible that the basic equation may become reversible as the charge passes through the cooler zone between the "hot spot" and the discharge. Then again from the theory of dissociation, the charge will certainly lose causticity because with a drop in temperature of the charge, the CO_2 will recarbonate the "made" lime and our equation is reversible.

Burner Design

Burners of modern design, especially adapted to this problem, have overcome this condition by incorporating a flexibility in their firing that allows for the control of the calcining zone to any desired depth in the kiln (according to the length and diameter of kiln) while at the same time providing heat to keep the temperature of the charge up to dissociation temperature while it progresses down the kiln from the calcining zone to the discharge. Examples of the conventional type burners as well as the modern design burners are shown schematically in Fig. 2 and Fig. 3.

The burner of Fig. 2 is simply a jet that delivers the gas axially into the kiln at a high velocity, with the air supplied either by forced or natural draft. The burner of Fig. 3 is a rotating burner that utilizes the energy of the fuel gas under pressure to perform work. The gas discharging from orifices drilled in the driver arms causes the driver assembly to revolve and drives the burner fan. The driver arms revolve in a plane that covers the incoming air stream thus the gas and air are mechanically mixed in the correct proportions at the point of entrance into the firing hood. It is the heat from this combustion pattern that keeps the charge up to dissociation temperature until the discharge.

The control of this source of heat is entirely separate from the "gas gun" through the center of the burner. This "gas gun" supplies the gas for the "hot spot", or calcining zone, and is controllable to any desired depth into the kiln. Fig. 4 and Fig. 5 show diagramatically the method of firing and flame appearance in the kiln from the burners shown in Fig. 2 and Fig. 3 respectively, together with graphic curves of representative temperatures obtained through kilns employing the two types of burners.

In Fig. 4 we see the "hot spot" projected up into the kiln from the conventional type burner to a distance of from 20′ to 40′, depending on the burner limitations, and the corresponding "cool" zone between the calcining zone and the discharge. These burners may or may not employ forced draft equipment but in either case the general appearance is the same. Fig. 4A. is a representative temperature curve obtained throughout the kiln with the kiln length as the abscissa and temperature as the ordinate of the graph. The temperature of the stack or charge end of the kiln will be in most cases, higher than that obtained from the burner shown in Fig. 3. And further, the temperature curve will reach a sharper peak and fall off faster, which condition does not lend itself admirably to controlled operation.

In Fig. 5 we see the flame pattern obtained from the burner shown in Fig. 3. Here the controllable "hot spot" is shown together with the pattern of combustion that keeps the charge temperature up to the point of dissociation until the discharge. The calcining zone is described as "surface combustion" or a yellow stationary flame, while the heat release from the revolving arms of the burner is classified as "primary" and "secondary combustion" and will be invisible when the kiln is radiant.

The temperature gradient throughout the kiln is shown as a curve, Fig. 5A, with the length of the kiln as the abscissa and temperature as the ordinate. It will be noted that the temperature of the stack or charge end of the kiln is lower and that the temperature curve is fairly level to the discharge. This prevents the recarbonization of the "made lime" by the CO_2 in the kiln due to a temperature drop of the charge prior to discharge.

The thermal dissociation of $CaCO_3$ is nothing more than a process of drying the charge of $CaCO_3$ slurry and controlling the temperature curve of the kiln in order to make lime of the highest per cent

FIG. 4. METHOD OF FIRING AND FLAME APPEARANCE WITH CONVENTIONAL BURNER SHOWN IN FIG. 2.

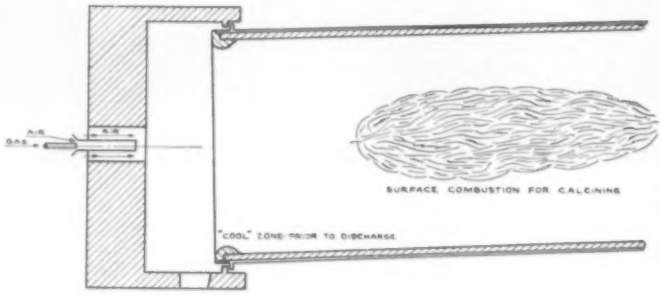
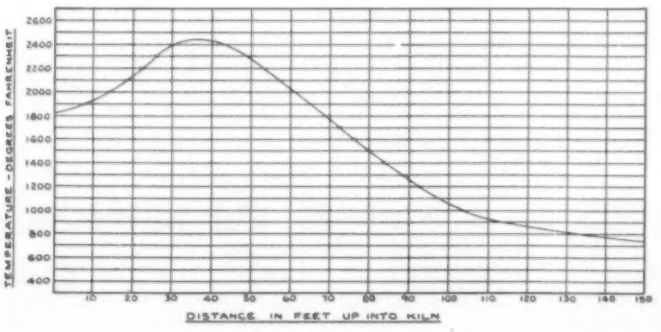


FIG. 4A. REPRESENTATIVE TEMPERATURE CURVE FOR FIRING SHOWN IN FIG. 4.



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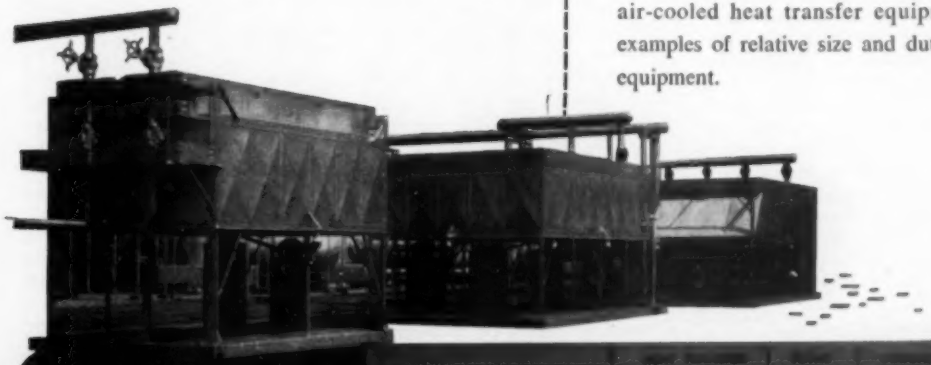
For many years, Fin-Fan Air-Cooled Heat Exchangers have proved their worth by giving reliable, economical service in many and varied applications. The Fluor Corporation, Ltd., and Griscom-Russell Company, pioneer-partners in the air-cooled heat transfer field, offer the following to show the large variety of practical applications for air-cooled heat transfer equipment and examples of relative size and duty of such equipment.



GAS COOLING	Natural Gas After-Cooler	13,920,000	80	46' x 25'
	Manufactured Gas Cooler	11,165,000	50	23' x 21'
	Natural Gas After-Cooler	3,400,000	15	11' x 21'
	Natural Gas Inter-Cooler	7,890,000	40	23' x 21'
VAPOR CONDENSING	Reflux Condenser	18,407,000	90	48' x 25'
	Primary Condenser	4,652,000	40	11' x 23'
	Still O.H. Condenser	4,875,000	34	16' x 21'
	Debutanizer Condenser	11,930,000	60	23' x 25'
	Still Reflux Condenser	39,110,000	60	46' x 25'
	Steam Condenser	87,300,000	300	138' x 31'
	Steam Condenser	2,880,000	10	10' x 6'
LIQUID COOLING	Vegetable Oil Cooler	628,000	15	6' x 17'
	Absorption Oil Cooler	14,915,000	100	32' x 17'
	Quenching Oil Cooler	1,663,000	50	23' x 25'
	Amine Solution Cooler	19,300,000	175	38' x 25'
	Stabilized Crude Cooler	125,100,000	700	315' x 25'
	Jacket Water	2,400,000	5.5	16' x 12'
	Jacket Water	28,800,000	100	70' x 24'

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causticity. To this end the burner shown in Fig. 3 affords the desired heat liberation characteristics due to its flexibility. In any process that calls for the drying of a wet charge, of any per cent solids, a gradual, even application of the heat to dry the charge is always desirable. In the problem under consideration it will easily be seen that the even rise of the temperature curve shown in Fig. 5A is that most desirable.

By applying the heat in such a manner, the tendency of the charge is to form a homogeneously dried mass of correct lump size prior to entry into the calcining zone. If the drying process is too rapid, as the charge progresses down the kiln, too large lumps will be formed and consequently will not undergo complete dissociation in the calcining zone simply because the center of the lumps may not be raised to dissociation temperature. The natural result of this is a prohibitive percentage of rejected "lump lime" and the overall efficiency of the kiln is lowered.

Prevention of Rings

Another and perhaps the greatest menace encountered from improper temperature control in the kiln is the formation of "rings" or the solid mortar like formation that builds up in the kiln. This formation impedes the natural flow of the charge and in general destroys the continuity of the kiln, resulting in frequent, expensive shut-downs for removal of the "rings."

There are several explanations advanced as to the cause for ring formation and all with grounds for support. However, in the opinion of the author, the following is the most simple and logical, and a solution to the problem is offered.

In dealing with any substance with the characteristics of $CaCO_3$ or CaO in the slurry form, whether in the lime kiln or as mortar used in construction, we are constantly confronted with the possibility that it will "set up". In the case of the rotary kiln the danger is enhanced as a result of the temperatures and conditions involved. It is only natural then as the slurry charge progresses down the kiln against rising temperature in the presence of CaO dust carried by the draft, that a too high temperature or sudden rise in temperature will cause a portion of the charge to "set up". As a result of the rotation of the kiln this deposit will form a ring and once the formation starts it is progressively faster until the ring is so large a shut-down is necessary to remove it.

Consequently, the logical solution to this problem is to keep the calcining zone or "hot spot as near to the discharge end as possible. By so doing we reserve a maximum of the kiln length for use in drying the charge prior to calcining. At the same time the draft should be held as low as possible to prevent carrying too much lime dust through the kiln. Low draft has a two-fold benefit—the mortar ring formation is abated and at the same time the stack loss of dust is reduced.

The use of burners as shown in Fig. 3 affords the necessary flexibility in firing characteristics to allow the calcining zone to be held near the discharge end of the kiln. At the same time, as previously explained, these burners are able to operate under a very low draft, due to the ability of this burner to mechanically proportion the air and gas for primary combustion by utilizing the energy of the gas under pressure to drive the fan. Also the turbulence in the lime dust, set up by the high velocity of axial firing jet burners is escaped, thus the causes of dust being carried through the kiln are combated.

The stack temperature of a kiln fired with the burner shown in Fig. 3 would be lower than in the same kiln fired with a conventional type burner. But this, of course, does not mean that the stack temperature of every kiln will be the same even when fired by the burner as in Fig. 3. The temperature will vary with each length and diameter kiln as well as with the weight of charge.

FIG. 5. METHOD OF FIRING AND FLAME APPEARANCE WITH THE MODERN BURNER SHOWN IN FIG. 3.

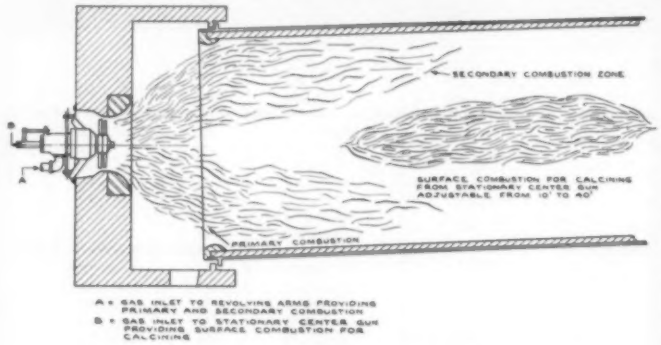
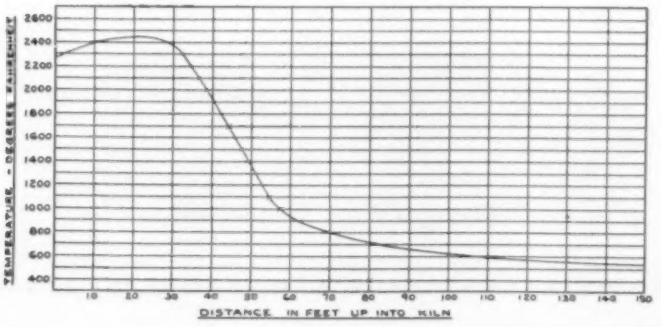

SECONDARY COMBUSTION ZONE
SURFACE COMBUSTION FOR CALCINING FROM STATIONARY CENTER GUN ADJUSTABLE FROM 10° TO 40°
PRIMARY COMBUSTION
A = GAS INLET TO REVOLVING ARMS PROVIDING PRIMARY AND SECONDARY COMBUSTION
B = GAS INLET TO STATIONARY CENTER GUN PROVIDING SURFACE COMBUSTION FOR CALCINING

FIG. 5A. REPRESENTATIVE TEMPERATURE CURVE FOR FIRING SHOWN IN FIG. 5.



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How to Replace Standby Storage Batteries

FROM time to time it becomes necessary to install new standby storage batteries, and at these times it is often highly desirable to make the changeover without interruption of service. One method of achieving this end is shown in the diagram.

Step 1 shows two sets of 12 cells, the shaded cells representing the new battery to be installed. In the top row, the old battery is completely connected to the circuit and the new battery is connected in groups of six cells each. This gives an opportunity to inspect the new cells thoroughly before disturbing the old circuit. By tying the new cells together, it can be determined whether the cells are in good order ready for installation. In addition, any shortage of connectors or other parts will be immediately apparent.

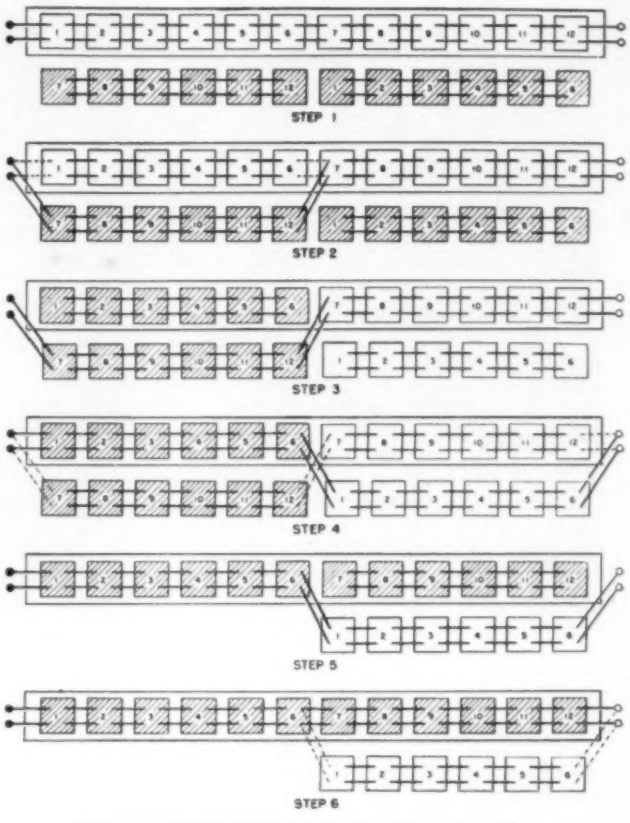
In Step 2, flexible leads have been connected to cell 7 of the new battery from the same terminal as those connected to cell 1 of the old battery. Connectors to be removed are indicated by dotted lines. Flexible connectors have also been installed between cell 12 of the new battery and cell 7 of the old battery. This allows removal of connectors between terminal and cell 1 and also the connectors between cells 6 and 7 of the old battery without breaking the circuit. The circuit now becomes cells 7, 8, 9, 10, 11 and 12 in the new battery, and cells 7, 8, 9, 10, 11 and 12 in the old battery. Cells 1 to 6 in the old battery can be removed and replaced with cells 1 to 6 of the new battery.

Cells 1 to 6 of the old battery are placed on the floor and connected in series so that they can be used to maintain a full circuit in Step 4.

Step 4 is similar to Step 2. However, in this case, when cells 7 to 12 in the old battery are removed from the circuit, they are placed in the packing case in which the new battery arrived and removed from the battery room. This is indicated in Step 5.

In Step 6 the final connections are made and the old batteries completely removed from the circuit.

The illustration with full instructions is available on an 8½x11 inch sheet suitable for insertion in reference notebooks. Copies may be had by writing the Gould Storage Battery Corporation, Trenton 7, N. J. Refer to "Gould Technical Bulletin, GB-1084".



Initial Operation of Centrifugal Boiler Feed Pumps

THE initial operation of centrifugal boiler feed pumps is accompanied by certain hazards which may be minimized by taking necessary precautions.

It is axiomatic that the pump and its driver must be mounted on a suitable foundation and properly aligned. In aligning, due allowance must be made for differential expansion in a vertical direction resulting from thermal expansion of the pump and its driver. The coupling between the pump and driver should be of the so-called "flexible" type which insures that no thrust will be imposed on the pump by the driver and vice versa. Coupling alignment should be rechecked after the pump has operated long enough to reach maximum operating temperature. Following this "hot check" the pump and

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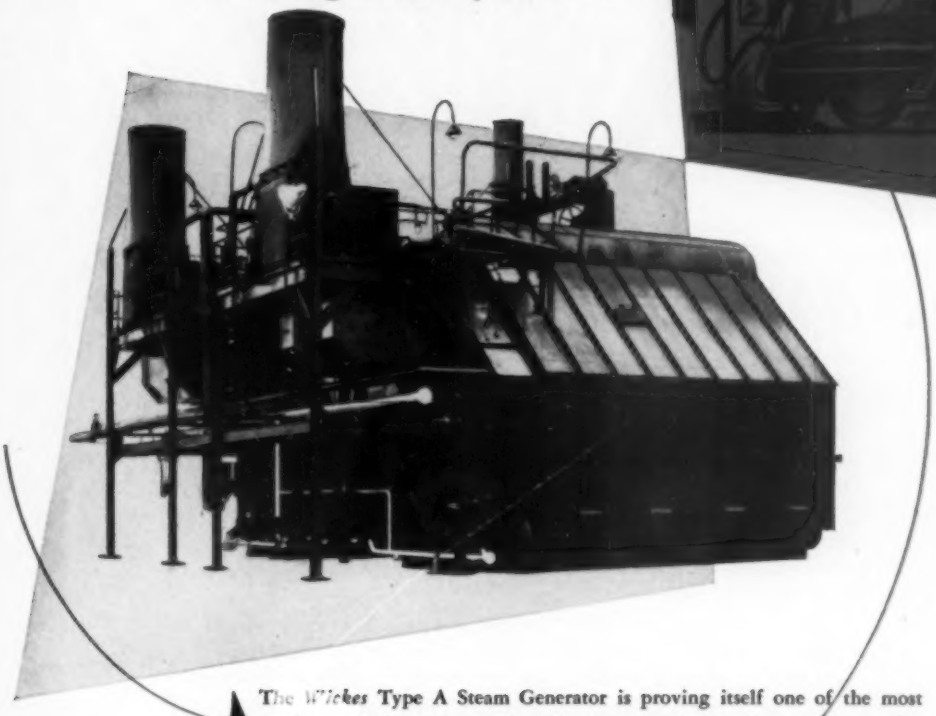
at work in new Texas natural gasoline plant . . .



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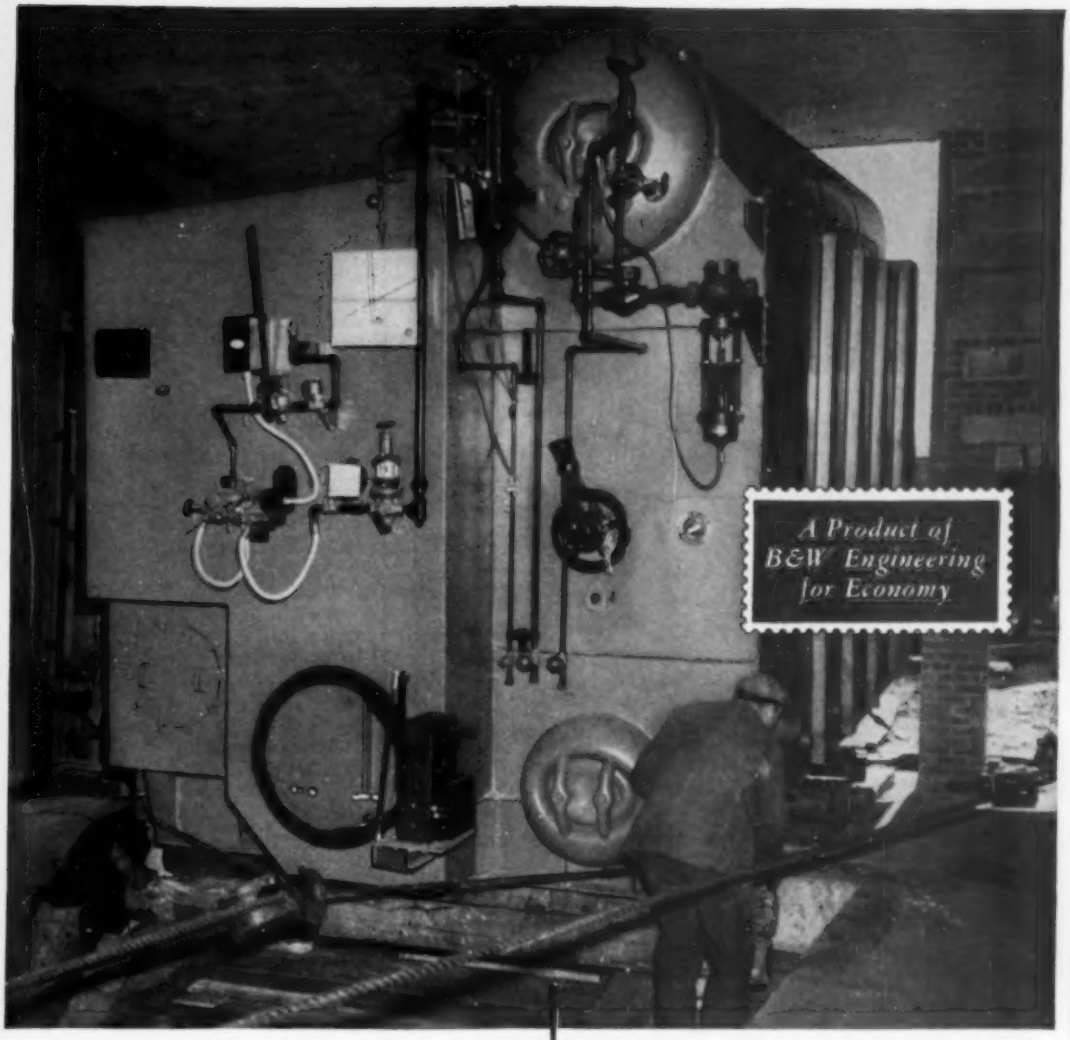

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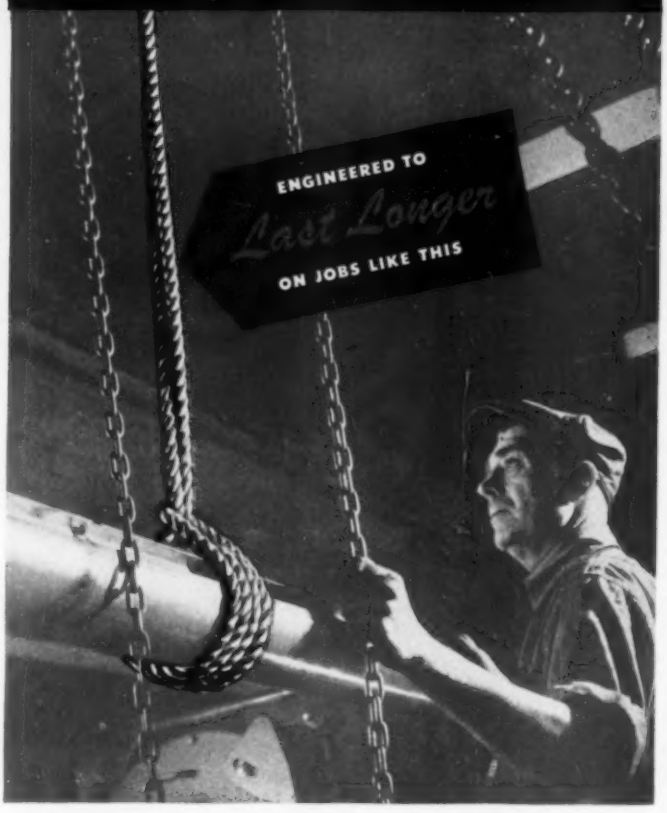

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driver may be dowelled to the bedplate.

The piping connecting to the pump must be so supported that no appreciable stress is imposed on the pump. The suction piping should be as straight as possible and free from potential air and vapor traps. Pump manufacturers are generally quite willing to review proposed piping layouts and approve the design or make constructive suggestions relating to suction lift or suction head as the case requires.

Every effort must be made to prevent foreign matter from entering the pump. Prior to connecting the piping, the suction and discharge openings should be kept constantly covered. The piping should be carefully cleaned internally before it is secured to the pump. While cleaning the piping it is advisable not to overlook the interior of valves, particularly those which have seat rings seal welded to the valve body. Slag is sometimes found adhering to the seal welds in objectionable amounts. If there is the slightest doubt about the cleanliness of the pump it should be opened for inspection and cleaning.

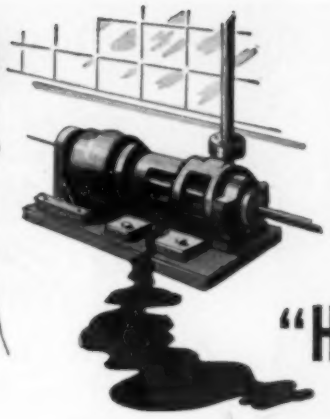
A sturdy strainer should be installed as close as possible to the pump suction. The strainer mesh should be small enough to hold all particles of a size that could not safely be passed through the pump. The strainer should be supported so that there is no chance of it collapsing or rupturing if it were to become completely clogged.

The pump suction and discharge should be equipped with suitable pressure gages. The suction gage should be mounted between the pump and the strainer so that fouling of the strainer may be detected.

When required, a supply of cool, clean, soft water should be provided for bearing cooling, gland jacket cooling, and for the smothering glands.

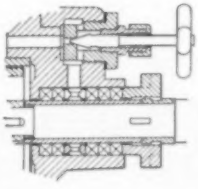
The bearings of the pump and drives should be flushed out with flushing oil and filled to the proper level with new oil. The coupling should be lubricated with oil

(*Boiler Feed Pumps Continued on page 95*)



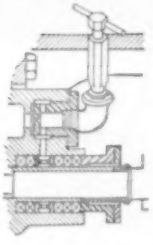
Are you looking for a pump that's REALLY "HOUSEBROKEN"?

Here's how Ingersoll-Rand MOTORPUMPS solve your leakage problems.



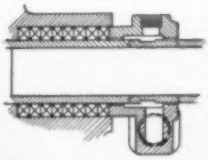
STUFFING BOX

The conventional stuffing box as furnished on MOTORPUMPS with integral H.P. motors is extra deep and holds 5 or more rings of packing and a seal cage. It is usually used on water or non-volatile liquids at moderate temperature. The standard gland is a split, two-piece type for easy removal from the shaft.



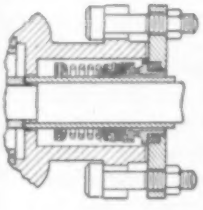
GREASE SEAL

When handling gasoline or other hydro-carbons, MOTORPUMPS can be equipped with a Merco-Nordstrom lubricator or grease seal. A special compounded stick lubricant is forced into the gland under pressure, effectively sealing and lubricating the packing.



SMOTHERING GLAND

When handling hot and volatile liquids, a split-type smothering gland is used in place of the standard gland. Water is circulated through the smothering gland and effectively smothers and carries off escaping steam, fumes or liquids which might be objectionable or hazardous.



MECHANICAL SEAL

Type JCS mechanical seals are standard on MOTORPUMPS with fractional H.P. motors and optional on integral H.P. units. These seals are furnished when conditions call for dripless and tamper-proof stuffing boxes requiring a minimum of maintenance. Lubrication and cooling are effected by the liquid being handled. Drip pans and drain lines are eliminated.

Although leakage is probably the plant engineer's No. 1 pump problem, you'll find that the I-R MOTORPUMPS have been designed to solve the many other maintenance problems with equal effectiveness.

Your nearest I-R representative will be glad to give you the complete story and help you select the MOTORPUMP that's best suited to your particular requirements. Sizes from ¾ to 5" are available for capacities from 5 to 1800 GPM. Shipment can be made promptly from stock.

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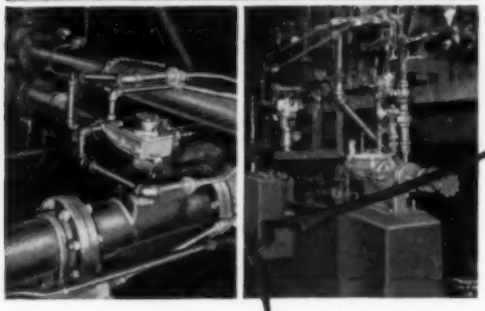

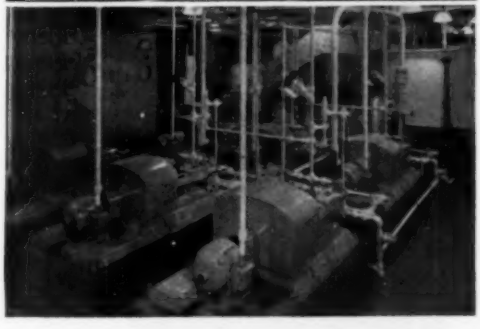

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Technical service representatives in principal cities of the United States, Canada, Mexico and other foreign countries.

(*Continued from page 92*)

or grease if it is designed for lubrication.

Starting Precautions

Before starting the pump it should be filled with water through the suction line and all air should be bled off through the casing vents. To assist in venting the pump it may be turned over manually several revolutions to release air trapped in the impellers. The warm-up line (if one is provided) should be used to bring the pump up to normal operating temperature.

Cooling water flow should be established to the bearings, jacketed glands, and smothering glands.

It is assumed that the pump has been properly packed and the correct rotation has been verified.

If the pump is to be started against a closed discharge, provision must be made to secure a safe minimum flow through the pump by means of a bypass recirculation valve, orifice, or choke.

In the initial operation the pump should be rapidly brought up to full speed so that if abrasive matter enters the pump it will be rapidly flushed through and out of the pump instead of being ground slowly between the stationary and rotating parts of the pump.

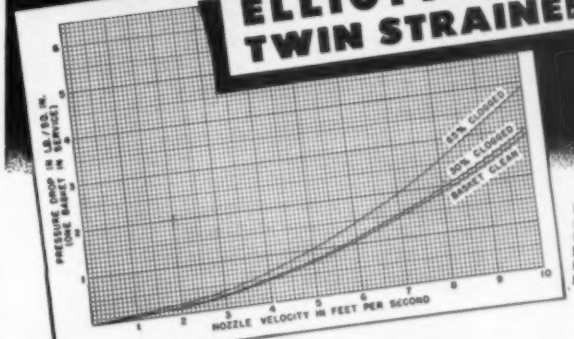
During the first few minutes of operation the suction and discharge pressures should be noted and if either shows a significant variation below design values the pump should be immediately shut down and the cause determined. The most common cause is air or vapor binding of the pump.

Bearing temperatures and bearing oil pressures should be noted. The oil rings should be checked to see that they are turning.

A slight overheating of the pump glands is to be expected until the packing has a chance to wear in and accommodate itself to the shaft. It will probably be necessary to shut down the pump and start it several times during the wearing in process. It is advisable to supply an excess of water to the jacketed glands and the smothering glands for the first few hours of operation. It also helps the packing to permit a generous

BIGGER BASKETS cut pressure drop

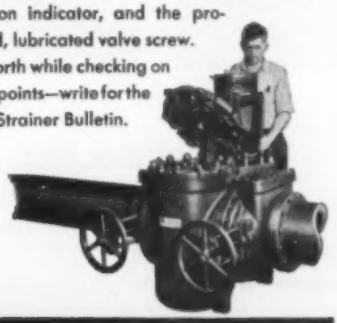
ELLIOTT type A TWIN STRAINERS



From a test made at the University of Pennsylvania Hydraulics Laboratory.

■ One of the major reasons for the low pressure drop of this recently redesigned line of non-stop strainers, is the generously large basket capacity—a 5 to 1 ratio with standard mesh. Even when clogged with foreign matter to the point where cleaning becomes necessary, the pressure drop is less than 2 feet of water at a velocity of 4.5 feet per second

Maintenance is cut, too. Big baskets mean fewer clean-outs, and the strainer going longer without attention. Other features are the two-way gate valves that really seal, the replaceable valve seats (optional), the easily removable valve disc, the quick-visible valve position indicator, and the protected, lubricated valve screw. It's worth while checking on these points—write for the Twin Strainer Bulletin.



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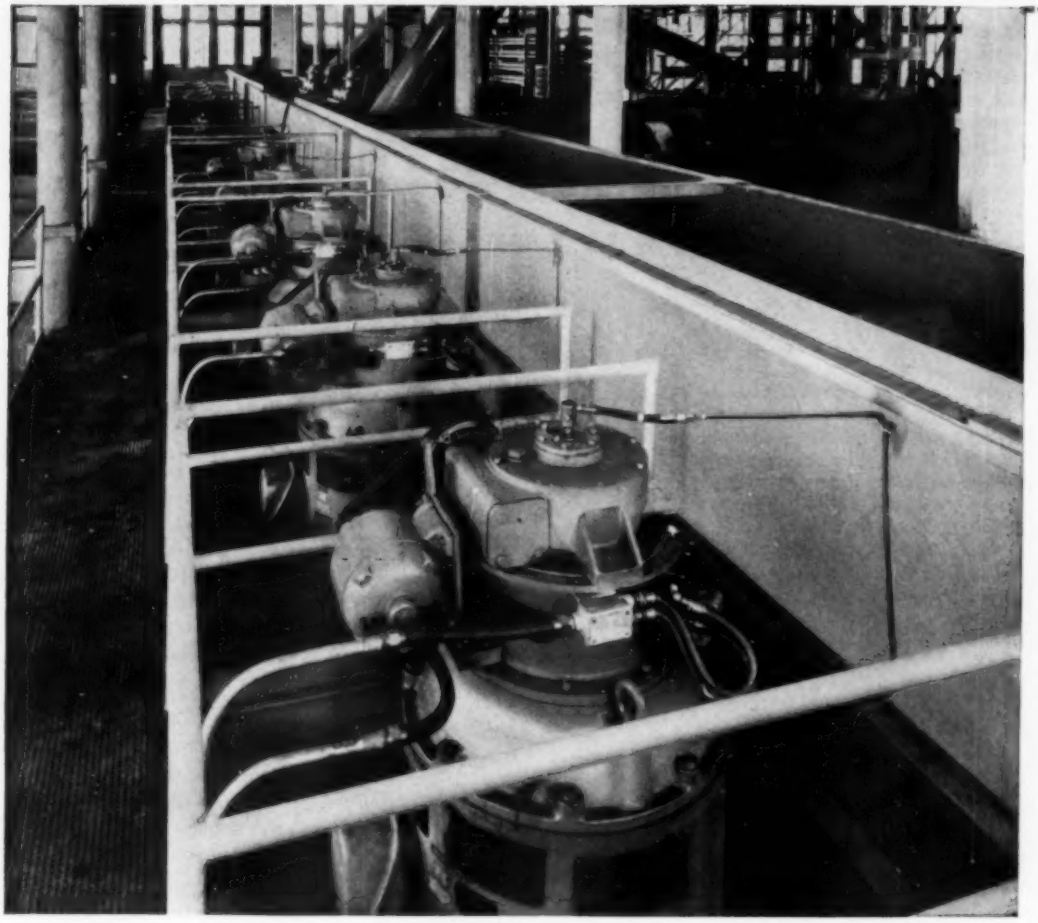


SOUTHERN FOOD PROCESSING . . . *BIG, BASIC, GROWING*

Biggest of all Southern industries is food processing. Yearly gross now tops $7 billion —up 3½ times in ten years. Another 100,000 workers added to the labor force since 1939 helped raise the figure.

Major electrical improvements help too. When The American Sugar Refining Company installed the Westinghouse equipment shown above in its Chalmette, New Orleans refinery, efficiency of the first process step and working conditions were greatly improved. These motors drive "centrifugals" which separate the molasses film from the raw sugar crystals—the first step in the refining of Domino Sugars. They first run at low speed, switch into high, slow down by regenerative braking (which feeds power back into the system), then stop. And nobody touches a button. Once started, the cycle is automatic. Moreover, by replacing a cumbersome shaft-belt-clutch arrangement, these motors save space, wear, maintenance.

This kind of engineering cuts costs, boosts profits, helps industry grow. It can be applied to your operation.

WHY ARE SOUTHERN BANK DEPOSITS UP *3½ Times* SINCE 1939?

In 1939, Southern bankers could count up $7.5-billion in deposits. Now take a look at the total in 1949: *twenty-seven billion. In one ten-year period, the South boosted its deposits 256%—while banks in the rest of the U. S. gained just 156%.*

Where did all the money come from? Why did the South gain so much faster? The main reason: Southern industry is growing faster. Since 1939, the basic industrial yardstick, manufacturing employment, has climbed over 20% faster in the South than in the rest of the U. S. That's what is putting money in Southern banks!

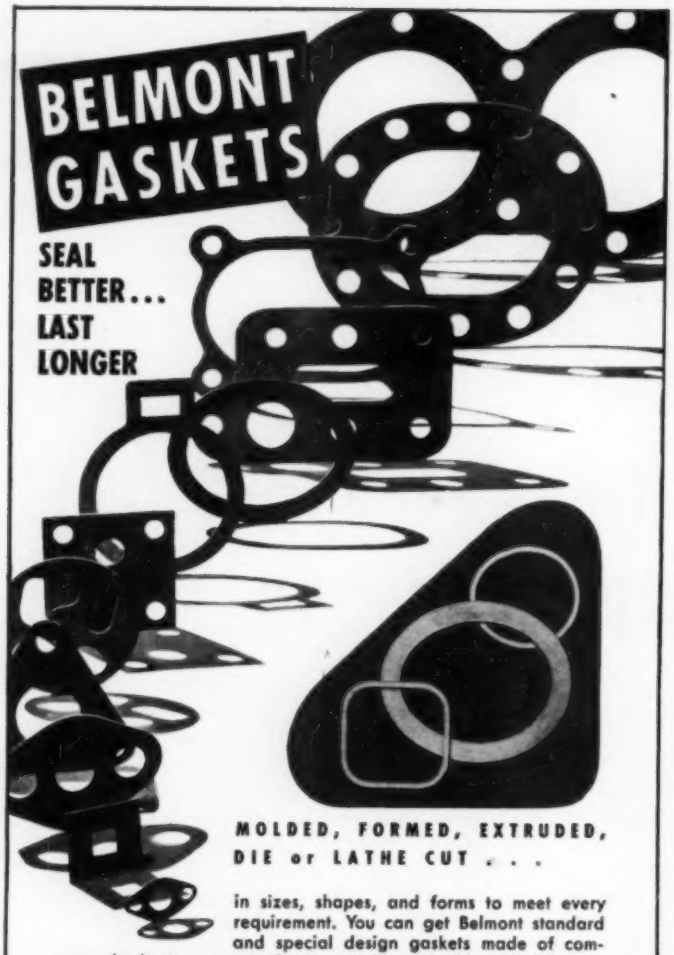
A significant factor in this dynamic progress is the Westinghouse organization. Electric power is basic to industrial growth. And Westinghouse has helped in two major ways: first by engineering the apparatus that generates a big share of Southern power; second by helping Southern industry *use* this power most efficiently. The sugar refinery drive at left is a good example.

With a long-time record as a Southern producer (13 plants today), Westinghouse knows Southern industry and power. We have a basic interest in their future growth. When you have a problem in making or using power, your Westinghouse office is a good place to go.

J-94830

Westinghouse

A BASIC PART OF THE SOUTH



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RINGS, SPIRALS, COILS, REELS, SPOOLS, SHEETS, GASKETS

(*Continued from page 98*)

leak off of water through the glands initially.

While in operation the pump should be examined for leakage at the casing joints, cover bolts, drain plugs, and between the shaft and shaft sleeves. Any leakage found should be promptly eliminated to forestall serious deterioration.

Following the first four to eight days of operation the suction strainer should be removed and left out of the suction line.

TECHNICAL BOOKS

Power System Stability, Vol. II

By Edward W. Kimbark
Published by John Wiley & Sons, Inc., 440 4th Ave., New York 16, N. Y.
6x9 inches—288 pages.
Price, $8.00.

Volume II of "Power System Stability" covers power circuit breakers and protective relays, including material on rapid reclosure of circuit breakers and performance of protective relays during swings and out-of-step conditions. The publication of this material in a separate volume makes it useful to those who are interested in power system protection even though they may not be particularly concerned with the subject of stability.

Volume I of the series covers "Elements of Stability Calculations". Volume III, to be published later, will endeavor to give the reader a deeper understanding of power system stability than that afforded by the first volume alone. It will deal with synchronous machines, excitation systems, damping, and saturation.

◆

Steam-Plant Operation

By Everett B. Woodruff and H. B. Lammers
Published by McGraw-Hill Book Company, 330 West 42nd St., New York 18, N. Y.
6x9 inches—543 pages.
Price, $7.00.

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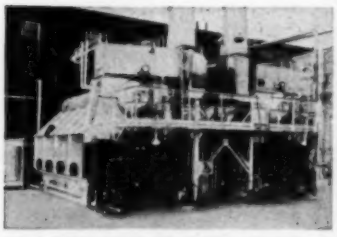
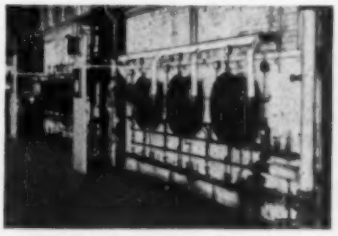
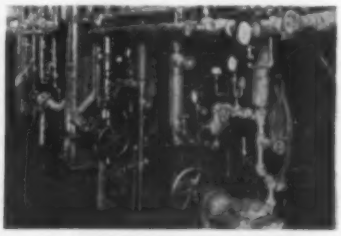


COMMERCIAL SOLVENTS CORP. plant, Terre Haute, Indiana, utilizes Coppus-Dennis FANMIX Oil Burners to fire two fully automatic 250 hp steam generators. Installed early in 1948, these two units have since been supplemented by a third.



AMERICAN WOOLEN CO., in one of its plants, has equipped two 1000 hp boilers with six Coppus-Dennis FANMIX Oil Burners.



BROCKTON EDISON CO. relies on four Coppus-Dennis FANMIX Oil Burners in its plant in East Bridgewater, Mass.

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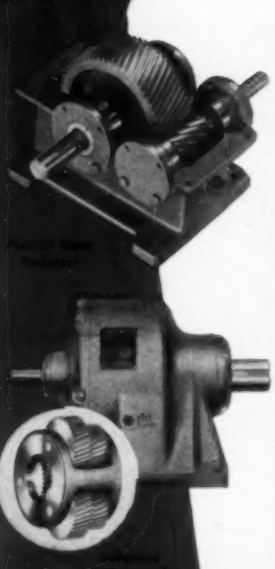

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Refrigeration Engineering

BY H. J. MACINTIRE AND F. W. HUTCHINSON

PUBLISHED BY JOHN WILEY & SONS, INC., 440 - 4th Ave., New York 16, N. Y.

6 x 9 inches—610 pages

Price, $6.50

The second edition of "Refrigeration Engineering" (based on the first edition by the late H. J. Macintire) has been compiled to supply the engineer with modern data on essential principles and with recent advancements of commercial machinery. The introductory chapters of the book are concerned with theory—fundamental thermodynamics and theoretical cycles of refrigerants, fluid flow, insulation, absorption and its allied cycles. Commercial equipment is described as well as special applications of refrigeration engineering.

Other chapters cover the analysis of transient phenomena in refrigeration; a concise treatment of the heat pump; comfort panel cooling systems presented in a detailed design procedure; illustrative figures, and problems. Graphical solutions give direct-reading values of the film coefficient of heat transfer for most of the commonly-used refrigerants when being heated or cooled as either a subcooled liquid or a super-heated vapor.

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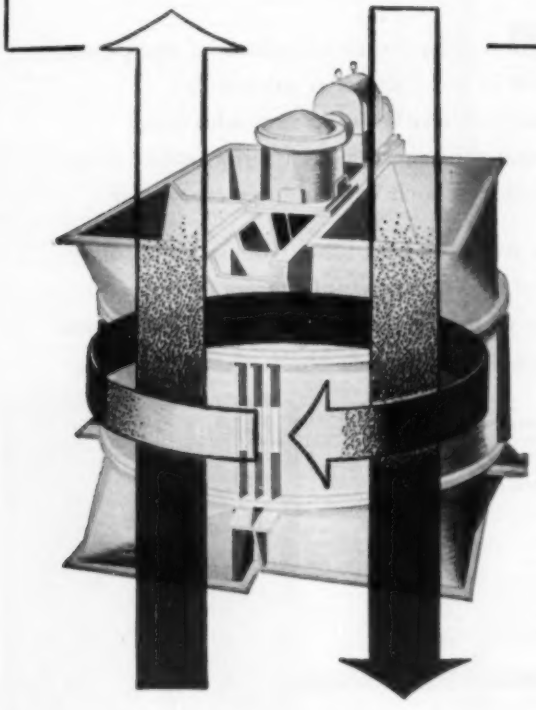

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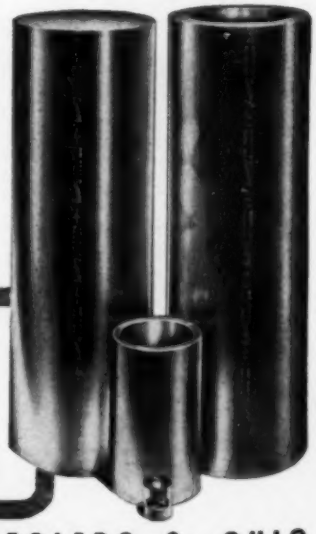

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1950 Design Survey of Typical New Steam Central-Station Installations

Compiled by B G A Skrotzki, Associate Editor

Company	Location	Plant Name	Consulting Engineers
1500 PSIG AND ABOVE			
Indiana & Michigan Electric Co	Lawrenceburg, Ind.	Tanners Creek	Amer. Gas & Elec Co.
Consolidated Edison Co of N. Y.	Astoria, Queens, N.Y.	Astoria	
Central Hudson Gas & Elec Corp.	East Fishkill, N.Y.	Danskammer	Burns & Roe, Inc
Jersey Central Power & Light Co	South Amboy, N.J.	South Amboy	Burns & Roe, Inc
Wisconsin Electric Power Co.			
Long Island Lighting Co	Glenwood Land'g, NY	Glenwood No. 3	Ebasco Services, Inc
Public Service Elec & Gas Co	Sewaren, N.J.	Sewaren	
1000 TO 1499 PSIG			
Toledo Edison Co	Toledo, Ohio	Acme	G W Sandhoff
Cincinnati Gas & Elec Co.	New Richmond, Ohio	Clermont	Electric Advisors, Inc.
Central Illinois Publ Service Co.	Hutsonville, Ill.	Hutsonville	Sargent & Lundy
Virginia Electric & Power Co	Wheelwright, Va.	Chesterfield	Stone & Webster
Carolina Pwr & Light Co	Lumberton, N. C.	Lumberton	Ebasco Services Inc
Carolina Pwr & Light Co	Goldsboro, N. C.	Goldsboro	Ebasco Services Inc
Niagara-Mohawk Pwr Corp.	Ni Albany, N. Y.	Albany	
New York State Elec & Gas Corp.	Johnson City, N. Y.	Gouley	Gilbert Associates Inc
Illinois Power Co	W. of LaSalle, Ill.	Hennepin	Sargent & Lundy
Florida Power & Light Co.	Ni Miami, Fla.	South Florida	Ebasco Services Inc
Potomac Electric Power Co.	Washington, D. C.	Benning	Stone & Webster
Duke Power Co	Mt. Holly, N. C.	Riverbend	
Duquesne Light Co.	Elrama, Pa.	Elrama	
Iowa Power & Light Co	Des Moines, Iowa	Des Moines, No. 2	United Lt & Rwy Serv. United Lt & Rwy Serv. Black & Veatch
Texas Electric Service Co	Fort Worth, Texas	North Main	Ebasco Services, Inc
Wisconsin Power & Light Co	Sheboygan, Wis	Edgewater	Sargent & Lundy
Georgia Power Co.	Yates, Ga	Yates	Southern Services, Inc.
Columbus & S. Ohio Elec Co.			Ebasco Services Inc
Minnesota Power & Light Co.	Aurora, Minn	Aurora	Ebasco Services Inc
San Diego Gas & Electric Co.	San Diego, Calif	Silver Gate	Pioneer Serv & Engg.
Pennsylvania Electric Co.	Erie, Pa.	Front St	Gilbert Associates, Inc
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	Avon Park, Fla.	Avon Park	Kuljian Corp
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		Black Dog	Pioneer Serv & Engg.
New York State Elec & Gas Corp.	East Corning, N. Y.	Hickling	Gilbert Associates, Inc
Eastern Shore Publ Service Co.	Vienna, Md.	Vienna	United Engrs & Constr.
Hydro-Elec Pwr Comm of Ontario	Toronto, Ont.	Richard L Hearn	Stone & Webster
	Windsor, Ont.	Windsor	H G Acres & Co.
Union Electric Power Co.	Venice, Ill.	Venice No. 2	Stone & Webster
Southern California Edison Co.	Redondo Beach, Calif.	Redondo	Stone & Webster
Hartford Electric Light Co.	Hartford, Conn.	South Meadow	Stone & Webster
Public Service Co of Colorado	Denver, Colo.	Arapahoe	Ebasco Services, Inc
Alabama Power Co.	Chickasaw, Ala.	Chickasaw	Southern Services, Inc.
	Hattiesburg, Miss.	Eaton	Southern Services, Inc.
Mississippi Power Co.	Meridian, Miss.	Sweatt	Southern Services, Inc.

A – Air cooled
AAA – Arrowhead Admiralty
AC – Allis-Chalmers Mfg Co
Ad – Admiralty
Ad' – Admiralty, inhibited
AlB – Aluminumbronze
AlBr – Aluminumbrass
AmAd – Amer. Admiralty
An
AsCo – Arsenical copper
BW – Babcock & Wilcox Co
C – Cast, bituminous
CE – Combustion Engineering Superheater, Inc
CP – C A Parsons
CuNi – Copper-nickel
D
DL – DeLaval Steam
EC – Erie City Iron W
EE – English Electric
EI – Elliott Co.
FW – F
G
GE

List Published in POWER, December, 1950

"Cleaner boilers at lower cost" . . . that is the reason why the central stations (the most critical buyers) express such overwhelming preference for Diamond Soot Blowers year-after-year-after-year. Diamond performance superiority is based upon better design, correct application engineering and the unique Diamond Service Policy.

At the time this advertisement was prepared, soot blower requirements had been purchased by all but three plants on the list. This will not significantly affect the result.

Diamond Dominates in Soot Blowers . . . now as in previous years . . . because Diamond Soot Blowers mean better boiler cleaning at lower cost.

DIAMOND POWER SPECIALTY CORP.
LANCASTER, OHIO
Diamond Specialty Limited, Windsor, Ontario

This Lubricant saved us $2,098.16"

"During the seven month period before using LUBRIPLATE No. 130AA in the bearings of our Kraft Mill Lime Kiln, we used a conventional oil of the density recommended. The cost of the lubricant for the period was $2,134.00. In the seven months that followed, we only used 128 lbs. of LUBRIPLATE No. 130AA for initial filling and replacement at the cost of $35.84. LUBRIPLATE No. 130AA only requires weekly applications whereas the former lubricant required daily application."

• • •

The Brown Company is a progressive organization that is continuously seeking ways to improve their products, their methods and to cut costs. Naturally, when they found LUBRIPLATE No. 130AA, a grease type lubricant with great adhesive qualities, high film strength, and with high heat resistance, they saw the possibility of using it to their advantage in the bearings of their kilns and other equipment.

LUBRIPLATE Lubricants are available from the lightest fluids to the heaviest density greases. They reduce friction, wear and power consumption, they prevent rust and corrosion, they last much longer than ordinary lubricants. There is a LUBRIPLATE Lubricant that is best for every lubrication requirement. Let us send you information about the use of LUBRIPLATE Lubricants in your industry. *Write today.*

LUBRIPLATE DIVISION—Fiske Brothers Refining Company, Newark 5, N. J., Toledo 5, Ohio.

DEALERS EVERYWHERE—CONSULT YOUR CLASSIFIED TELEPHONE BOOK

LUBRIPLATE *THE MODERN LUBRICANT*

NEWS

Hyster Company—Florida

AICHEL STEEL AND SUPPLY COMPANY of JACKSONVILLE, FLORIDA, has been designated new dealer for HYSTER industrial materials handling equipment in eight FLORIDA counties and 12 GEORGIA counties.

Office and warehouse of the Aichel Company is located at 2205 Edison Avenue, Jacksonville, Florida.

◆

Allis-Chalmers—San Antonio

JAMES H. JONES has been assigned as a sales representative to ALLIS-CHALMERS' SAN ANTONIO district office, according to an announcement by JOHN L. PRATT, Southwest region manager. Jones joined Allis-Chalmers in 1949 following graduation as an electrical engineer from Southern Methodist University. He is a member of the American Institute of Electrical Engineers.

FUTURE EVENTS Of Engineering Interest

AMERICAN SOCIETY FOR TESTING MATERIALS, Sec'y, 1916 Race St., Philadelphia 3, Pa.
March 5-9, Spring Meeting and Committee Week, Cincinnati, Ohio.

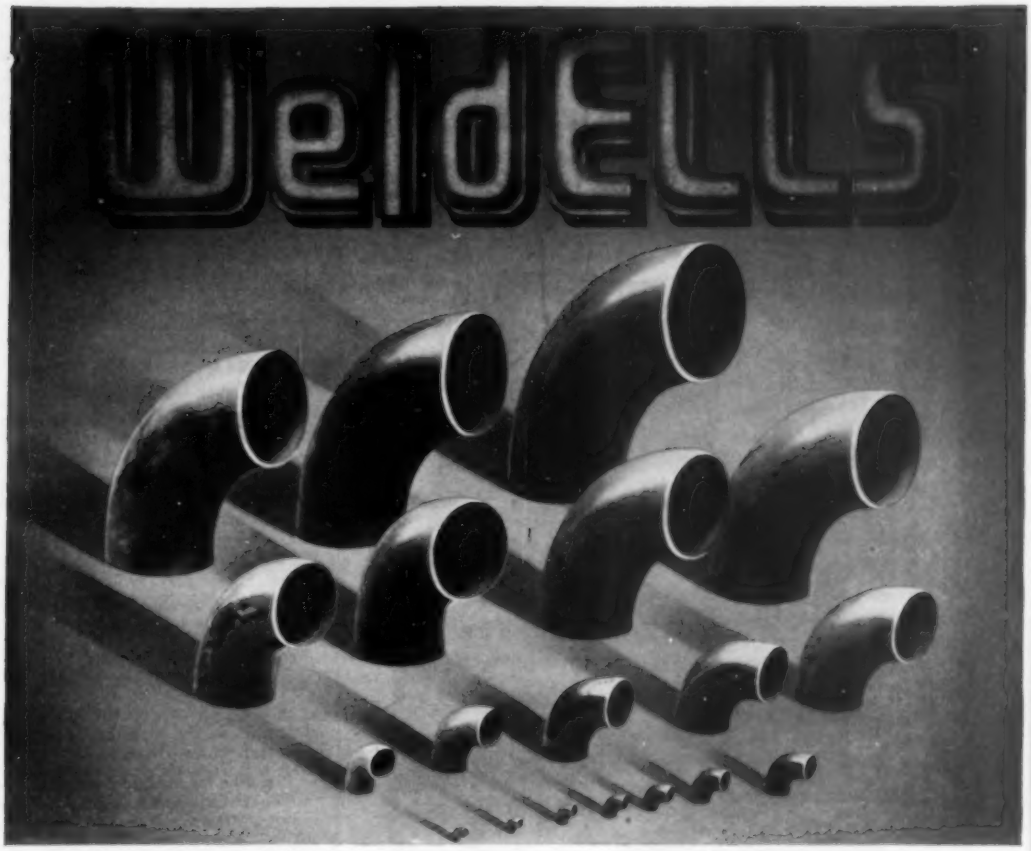
INTERNATIONAL INDUSTRIAL EXPOSITION, Ed G. Lenzner, Gen. Mgr., 41 San Jacinto St., Houston 2, Texas.
March 11-17, Coliseum, Houston, Texas.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, C. E. Davies, Sec'y, 29 West 39th St., New York, N. Y.
April 2-5, Spring Meeting, Hotel Atlanta-Biltmore, Atlanta, Ga.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, C. E. Davies, Sec'y, 29 West 39th St., New York, N. Y.
April 17-19, Process Industries Conference, Baltimore, Md.

NATIONAL MATERIALS HANDLING EXPOSITION, Clapp & Poliak, Inc., 341 Madison Ave., New York 17, N. Y.
April 30-May 4, Fourth Annual Exposition, International Amphitheatre, Chicago, Ill.

NATIONAL ASSOCIATION OF POWER ENGINEERS, INC., A. F. Thompson, Director of Exhibits, Suite 1050, 176 West Adams St., Chicago 3, Ill.
Aug. 21-23, Golden Anniversary National Power Show, Hotel Plaza, San Antonio, Texas.



Family Group . . . *proud of its size . . . and traditions*

Large group though it is, you see here only one branch of the world's largest family of fittings for pipe welding.

It is simply the stock sizes of long-radius WeldELLS in a single weight and material — merely a small fraction of the enormous line that includes more types of fittings, in more materials, more weights and more sizes than any other line.

Important though the breadth of the WeldELL line is to every man who designs or erects piping, still more important is the significant fact that the WeldELL family grew to this size because nothing less could meet the demand for fittings of WeldELL quality and uniformity to satisfy every conceivable piping condition.

Yes, there is a Taylor Forge Fitting for every purpose. From the smallest to the largest, every fitting in the WeldELL line shares the principle of sound engineering design and job-speeding utility that Taylor Forge has consistently applied for half a century.

Mail the coupon for Taylor Forge catalog.

TAYLOR FORGE

TAYLOR SPIRAL PIPE is available in a broad range of sizes and thicknesses. Coupon brings Spiral Pipe Bulletin 493.

TAYLOR FORGE & PIPE WORKS
P. O. Box 485, Chicago 90, Illinois
Offices in all principal cities.
Plants at: Carnegie, Pa.; Fontana, Calif.; Hamilton, Ont., Canada

☐ Please send Catalog 484 covering welding fittings and forged steel flanges.
☐ Send Bulletin 493 covering Taylor Spiral Pipe and related fittings.

NAME_____

POSITION_____

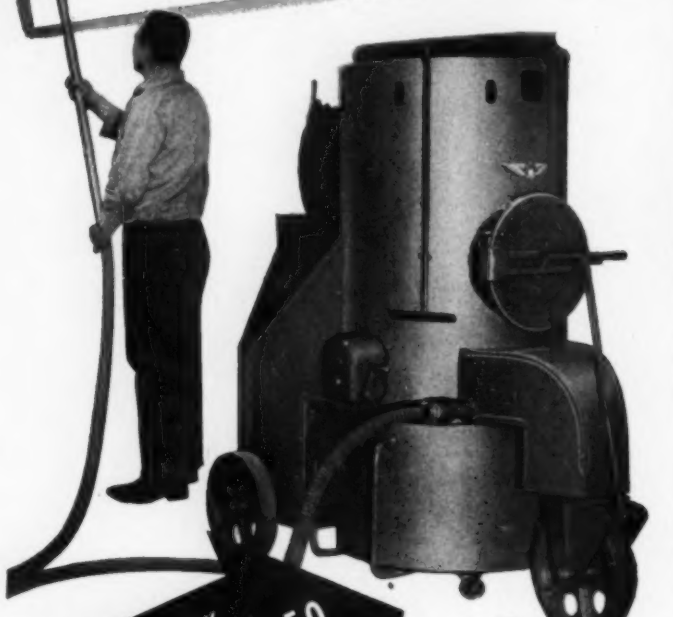
COMPANY_____

STREET ADDRESS_____

CITY_____ ZONE____ STATE_____

Mail to Taylor Forge & Pipe Works, P. O. Box 485, Chicago 90, Ill.
756-0251

HERE'S A HEAVY-DUTY HUSKY
with a 7½ cubic foot
DUST APPETITE!



The New
HOFFCO-VAC #50
PORTABLE
VACUUM CLEANER

WRITE FOR
BULLETIN A-794

★ Improved design, 5 H.P. model operates two 50-foot lines of 1½-inch hose simultaneously, or one 75 or 100-foot length of 2-inch hose.
★ Self-lubricated ball bearings.
★ Spring-mounted vacuum unit.
★ Longer operating period.
★ Easy dust disposal.

For high-capacity, continuous cleaning, the new Hoffco-Vac #50 is the all-purpose, two-sweeper machine! Specifically designed for use where large dust accumulations are to be handled—where non-stop cleaning is necessary—or where superior separation is a requirement. Handles like lighter, smaller machines. Successor to the famous Hoffco-Vac originated in 1939, the new #50 is one of 4 sizes of portables built by Hoffman. Stationary systems available, too, in a wide range of sizes. Write today for literature.

HOFFMAN BUILDS MULTISTAGE CENTRIFUGAL BLOWERS and EXHAUSTERS

All capacities up to 10,000 c.f.m. and various air pressures up to 8 lbs. Low maintenance and power costs. Write for Bulletin A-650.

AIR APPLIANCE DIVISION
U.S. HOFFMAN MACHINERY CORPORATION
82 EAST 125th STREET, NEW YORK 3, N. Y.
CANADIAN PLANT: CANADIAN HOFFMAN MACHINERY CO. LTD. NEWMARKET, ONT.

Double Seal Ring Representatives

Three new sales representatives have been appointed by DOUBLE SEAL RING COMPANY of FORT WORTH, TEX., it was announced by Buyrl Wilson, general sales manager.

The new sales representatives and their territories are: ALTON J. FARREY, eastern part of the state of New York; and the C. H. GARRISON COMPANY, the state of KANSAS and southwestern MISSOURI.

◆

50th Annual National Power Show Scheduled for San Antonio, Texas

The Golden Anniversary NATIONAL POWER SHOW of the National Association of Power Engineers, Inc., will be staged in SAN ANTONIO, TEXAS, August 21-23, 1951. San Antonio will be converted into a three day market center for power equipment, materials, and supplies.

Held in conjunction with the National Power Show will be the 68th Annual National Convention of the National Association of Power Engineers, Inc.

◆

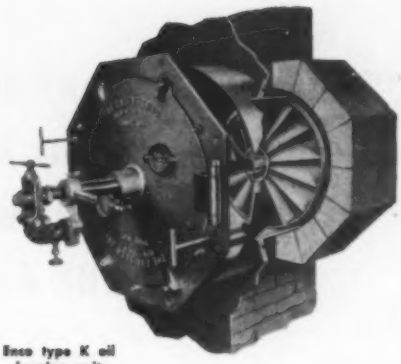
International Industrial Exposition Houston, Texas—March 11-17

Planning for the INTERNATIONAL INDUSTRIAL EXPOSITION which will be held in HOUSTON, TEXAS, from March 11 through 17, 1951, is now well under way. Exhibits and activities cover oil field operations, chemical industries, refining, and general industrial projects. Included in the last named will be power and its transmission, machine design and manufacture and services that facilitate industrial operations.

The many demonstrations of services and processes and of equipment in operation, as well as the coordination of research and experimental projects by educational institutions which are cooperating with the exposition management have required months of preparation. Preliminary arrangements for these have been completed to make sure that the show will be a means for the technical and scientific advancement of industry.

The object of the exposition is to provide a means for men in industry to see and study equipment for their particular use. Complimentary tickets are therefore being provided for men in all branches of industry. These tickets are available upon request to Ed G. Lenzner, General Manager, International Industrial Exposition, 41 San Jacinto St., Houston 2, Texas.

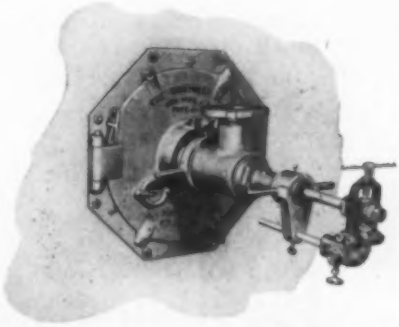
ENCO
OIL and GAS
BURNER UNITS



Enco type K oil burning unit

High load or low, you can count on completely uniform combustion and greater fuel economy with the Enco Type K Oil and Gas Burner Unit. It is flexible three ways . . . (1) designed for use with either oil or gas—or both, (2) flexible where steam demands swing sharply and (3) can be operated by either natural or forced draft.

ENCO BURNER UNITS ARE MADE in many sizes to suit all capacity requirements.



Enco type K gas-oil burning unit

Enco Interchangeable Atomizers

Wide Range Mechanical—Capacity range of 10 to 1. Manual or automatic control. Constant high oil pressure at atomizer insures efficient atomization over entire load range without recirculating or returning oil.

Steam or Air—Capacity range of 10 to 1. Controlled by manual or automatic pressure regulation.

Standard Range Mechanical—Available in all sizes to suit load and capacity requirements.

BULLETINS ON REQUEST
WRITE TODAY

Enco standard range mechanical atomizer gun

Enco wide range steam atomizer gun

Enco wide range mechanical atomizer gun, showing burner tip assembly

Enco gas burning gun

Enco standard atomizer gun support

THE ENGINEER COMPANY 75 WEST STREET, NEW YORK 6, NEW YORK

IN CANADA: F. J. BASKIN, LTD., 4220 IBERVILLE ST., MONTREAL 34 P.Q.

"We don't have any more needless fuse blows on our Air Compressor circuit since we installed FUSETRON dual-element FUSES"

"Prior to the time we installed Fusetron fuses to protect the circuit feeding the 125 h.p. 220 volt, 3 phase motor on our air compressor we were troubled with fuses blowing needlessly.

"On an average of once every two weeks one of the 400 ampere, 250 volt renewable fuses protecting the circuit would open on the starting current of the motor.

"About May of 1947 we replaced the fuses with 400 ampere Fusetron fuses. Since then we have not had the circuit down once because of a needless blow."

Leon C. England.
Chief Electrician
Link Belt Company
Indianapolis, Ind.

Fusetron Dual Element Fuses

give 10-Point Protection

1. * Protect against short circuits.
2. Protect against needless blows caused by harmless overloads.
3. Protect against needless blows caused by excessive heating — lesser resistance results in much cooler operation.
4. Provide thermal protection — for panels and switches against damage from heating due to poor contact.
5. Protect motors against burnout from overloading.
6. Protect motors against burnout due to single phasing.
7. Give DOUBLE burnout protection to large motors — without extra cost.
8. Make protection of small motors simple and inexpensive.
9. Protect against waste of space and money — permit use of proper size switches and panels.
10. Protect coils, transformers and solenoids against burnout.

* Fusetron Fuses have high interrupting capacity as shown by tests of the Electrical Testing Laboratories of New York City in December 1947.

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS

Act on the Facts

Don't risk losses in your plant

One **needless** shutdown,
One **lost** motor,
One **destroyed** panel or switch,
One **burned out** solenoid—

May cost you more than replacing every ordinary fuse with a FUSETRON dual-element fuse.

But, simply knowing that FUSETRON fuses do save money is knowledge — but it isn't action.

By passing the word along that all purchase and stock records should call for FUSETRON dual-element fuses, you have action that begets money saving.

What is the FUSETRON Dual-Element FUSE?

A fuse link combined with a thermal cutout—the result, a fuse with tremendous time-lag and much less electrical resistance.

They have the same degree of Underwriters' Laboratories approval for both motor-running and circuit protection as the most expensive devices made.

Made to the same dimensions as ordinary fuses, FUSETRON Fuses fit all standard fuse holders.

Obtainable in all sizes from 1/10 to 600 ampere, both 250 and 600 volt types. Also in plug types for 125 volt circuits.

Their cost is surprisingly low.

(FUSETRON is a trade mark of the Bussmann Mfg. Co., Division of McGraw Electric Co.)

Bussmann Mfg. Co., University at Jefferson
St. Louis 7, Mo. (Division McGraw Electric Co.)

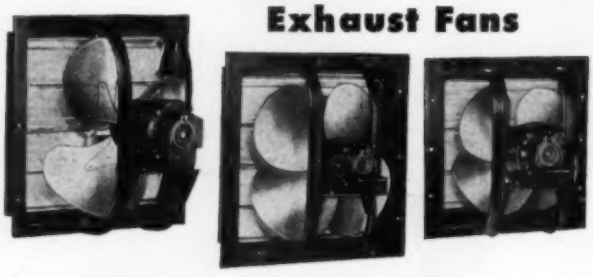
Please send me complete facts about FUSETRON Dual-Element FUSES.

Name_____
Title_____
Company_____
Address_____
City_____ State_____ 151

Get the facts . . . see for yourself the advantages of selecting your fan equipment for 1951, from the *most complete line* of quality fans in America! The new Emerson-Electric catalog for 1951 shows a complete line of oscillating fans, air circulators, ceiling fans, exhaust fans, in numerous sizes and types for every air-moving job. Write for Catalog No. 207 today.

THE EMERSON ELECTRIC MFG. CO.
St. Louis 21, Mo.

NEW! EMERSON-ELECTRIC Exhaust Fans



SAVE — with our new economy line, built for easy installation and rugged service! 12-, 16-, and 18-inch direct-drive fans, complete with automatic outside shutters mounted integral with fan frame. Write today!

BELT-DRIVE EXHAUST FANS — long-life, slow-speed models in 24-, 30-, 36-, 42-, and 48-inch sizes, exhausting up to 19,350 CFM.

DIRECT-DRIVE EXHAUST FANS — five top-quality models, blade sizes 12 to 30 inches. Fully-enclosed ball-bearing motors; quiet overlapping blade assemblies.

EMERSON ELECTRIC
MOTORS • FANS — APPLIANCES

Westinghouse and Georgia Power Sponsor Productive Power Show

At the December Atlanta, Georgia showing of Productive Power, WESTINGHOUSE ELECTRIC CORPORATION and the GEORGIA POWER COMPANY presented their unique illustrations of methods for improving the use of electricity to secure increased productivity in manufacturing. Each illustration presented the system, the processes to be accomplished, and the modern productive equipment which is available to accomplish the maximum results.

The presentation logically began with the wiring system needed to supply electrical apparatus. The effect of low over-loaded wires as reflected in reduced lighting and lower torque of motors was specifically presented. The valve of capacitors in increasing the voltage and saving wiring expense, completed the clearly presented picture of the need for adequate wiring.

Lighting

The next presentation was a step by step illustration of the effects of various types of lighting, showing the results of each step as progress is made from a bare lamp to the modern fluorescent fixture and special spot lighting.

The use of infra-red lamps for drying purposes was shown in a comparison with the time required for drying paint in forced air, in convection heating, and under radiant heat only. This demonstration clearly developed the speed of radiant heat drying over the other methods.

Electrostatics

The next feature gave the step by step operation of electric ionization for the cleaning of air. The tradename of this electrostatic equipment used is Percipitran, and its efficiency was illustrated by the effect on the removal of smoke, which is perhaps the hardest of all types of cleaning to accomplish.

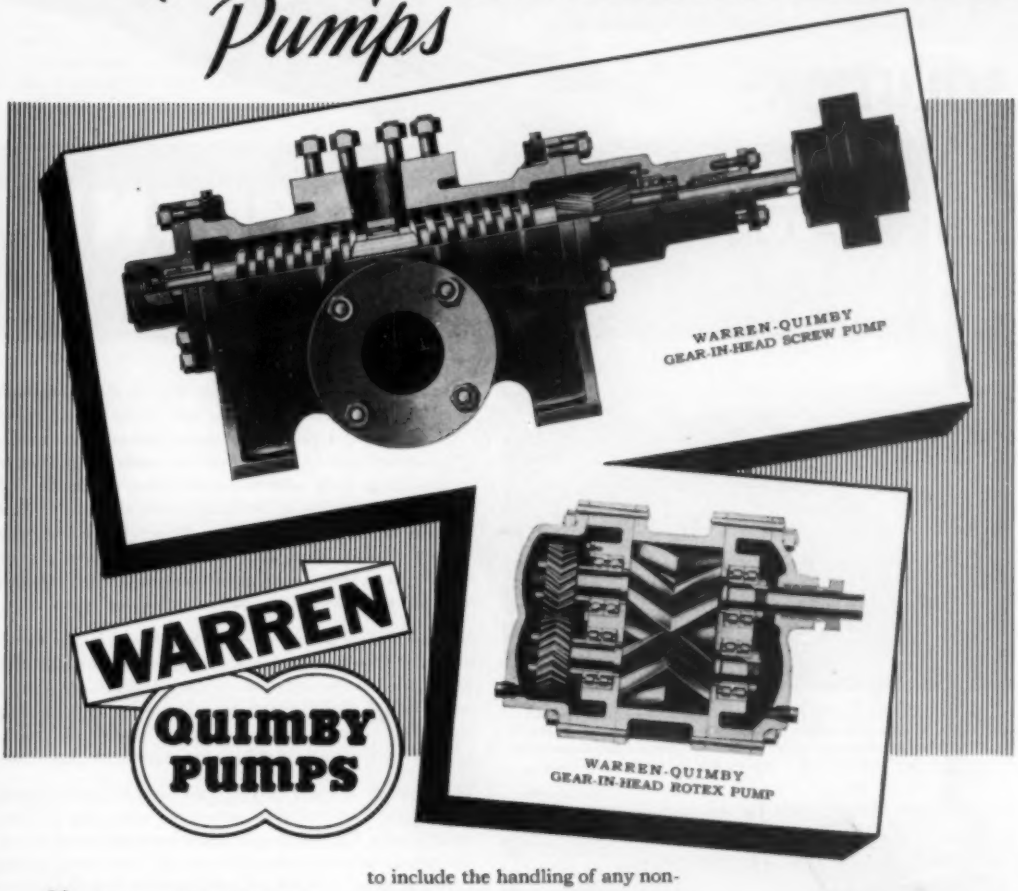
Welding

The values of resistance welding from a simplification and speed standpoint was shown with an automatic sequence welder which formed a series of welds automatically, resulting in welding strips of metal which presented a clean and sound joint, emphasizing this type of fabrication.

Induction Heating

The use of induction heating in metal working was presented in the form of a film, while the various uses of dielectric heating were mentioned. An

NOW *Quimby Pumps* WITH WARREN SERVICE



Now you can look to Warren for Screw and Rotary pumps as well as Centrifugal and Reciprocating types.

Quimby built the first balanced quadruplicate screw pump in 1893. The salient design feature of separate screws and timed driving gears have never been changed. However, refinements through the years have widened the scope of applications to include the handling of any non-abrasive liquid or semi-liquid at moderate and high pressures.

The "Rotex" is a superior rotary pump of unique construction that has numerous applications where moderate pressures are involved.

We are glad to add these new members to the Warren family and invite your inquiries on any problem involving Screw and Rotary, Centrifugal or Reciprocating Pumps.

Both Screw and Rotex type pumps are available either horizontal or vertical mounted.

FQ-1

WARREN PUMPS

WARREN STEAM PUMP COMPANY, INC., WARREN, MASSACHUSETTS

PLANT POWER-PROBLEM:

Costly outages caused by phase-to-phase flashovers and burndowns in open wiring strung in chemical atmosphere

SOLUTION:

OKOLITE-OKOPRENE

SELF-SUPPORTING AERIAL CABLES

COMPACT AND ECONOMICAL—Self-evident space economy combines with reasonable installation and low maintenance costs. 3/C #4/0 Okolite-Okoprene Self-Supporting Cables supply lighting for the various buildings.

DURABLE AND DEPENDABLE—Permanently weather-proof with no ring-cutting or lead sheath troubles. Long-lived, trouble-free circuits assured. 3/C, 500,000 CM Okolite-Okoprene 5 Kv Cables distribute power from sub-station to sulfite mill, beater room and screen room.

Dust, moisture and acid fog prevalent in the atmosphere surrounding the Rumford, Maine, mill of the Oxford Paper Company posed a problem in power circuit maintenance. The combination of these elements made it practically impossible to keep even the over-voltage insulators and wooden structures from becoming conducting to the point where even 2,300 volts resulted in phase-to-phase flashovers and burndowns. Moreover, burndowns of upper circuits would often cause loss of lower circuits through repeated burnouts as top wires dropped to underlying layers.

Solution of this serious problem was found in the substitution of Okolite-Okoprene Self-Supporting Aerial Cable for open wires. According to company officials, the combination of Okolite high voltage moisture and heat resisting insulation protected by non-conducting weather and chemical resistant Okoprene sheathing has eliminated this trouble.

With greatly reduced service interruptions and outages, Oxford engineers anticipate substantial reductions in maintenance costs. Other industrial users have had similar experiences and point out that this type of Okonite-engineered cable also gives improved circuit regulation because of lower reactance. In addition to its ***dependability***, they value it for *compactness*—to eliminate congestion, reduce clearance problems, afford a modern, streamlined appearance—and for *economy*...to save on installation as well as maintenance costs.

For outdoor or indoor installations, the industrial applications of Okolite-Okoprene Self-Supporting Aerial Cables offer convincing advantages. These are fully described in a 52-page manual available to electrical engineers and company executives. For your copy, send a request on your letterhead to The Okonite Company, Passaic, N. J.

THE BEST CABLE IS YOUR BEST POLICY

insulated wires and cables

illustration of one of the uses of dielectric heating was pointedly brought out by operating one of these ultra-high frequency machines for drying the glue on 5 layers of plywood in 40 seconds, giving a total thickness of approximately 8 inches. The resulting bond between this plywood was so strong that when struck repeatedly with a sledge hammer, the wood shattered instead of the glue joint breaking.

◆

Cordiner Succeeds Wilson—G. E.

The election of RALPH J. CORDINER, of New York, as President of the GENERAL ELECTRIC COMPANY to succeed CHARLES E. WILSON, named as chairman of the new Defense Mobilization Board, has been announced. Mr. Wilson submitted his resignation to the Board of Directors and announced that he was severing all connections with corporate and banking institutions.

Mr. Cordiner, who has been associated with General Electric for 24 years and has served as manager of five of the company's departments during that period, has been Executive Vice President and a director of the company since 1949. He assumes his new duties immediately.

◆

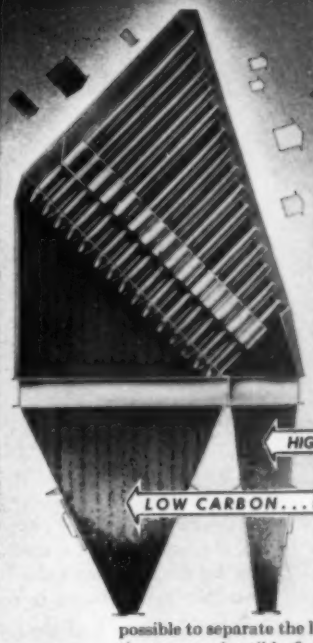
Alcoa—Defense Aluminum

The first pig of national defense aluminum to be produced by reactivated facilities of ALUMINUM COMPANY of AMERICA at BADIN, N. C., has been presented to General Services Administrator Jess Larson for the defense stockpile.

Earmarked for the nation's stockpile of strategic materials, the metal is the first of an additional 158,000,000 pounds to be produced annually by ALCOA-owned stand-by facilities at Badin and at Messena, New York. The extra equipment is not economical to operate because large amounts of low cost power are unavailable in these areas. It has been reactivated through an arrangement with adjacent public utility companies to supply high cost power.

Separate from this "quick action" program is an ALCOA expansion plan calling for the construction of permanent new capacity capable of producing additional metal at the rate of 240,000,000 pounds a year. This plan involves enlarging ALCOA's POINT COMFORT, TEXAS, smelting facilities and construction of a new aluminum reduction plant at a site still to be selected.

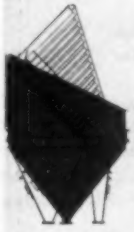
REFIRE HIGH CARBON DUST
without recirculating fly-ash



. . . install pd

TUBULAR DUST COLLECTORS *arranged for* DECANTATION

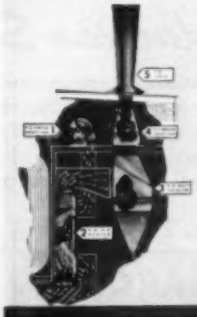
In a single phase P-D tubular collector, designed for decantation and *requiring no additional pressure drop*, it is now possible to separate the large particles of high carbon content from the non-combustible finer particles.



Fly-ash from spreader stoker-fired units, consisting of up to 40% high carbon particles, can effect considerable savings when re-injected. It is necessary to effect separation, however, since the non-combustible smaller particles remaining in the system increase in concentration, causing erosion and possible poor combustion due to spotting.

Space requirements for the decantation design are not as great in area and only slightly higher than a standard tubular . . . and, collection efficiency is high. Superimposed sketch shows comparative size.

Why waste fuel? Investigate this collector today, it will soon pay for itself. Write our Sales and Project Engineers for Bulletin 260 D.



UNIT RESPONSIBILITY

Prat-Daniel, through its sales and project engineers, The Thermix Corp., offer a complete complement for handling the air gas stream: Forced Draft Fans, Air Pre-heaters, Tubular Dust Collectors, Induced Draft Fans and Fan Stacks. This unit responsibility, by a well known firm, relieves the engineer of the responsibility for one of the most important functions in a steam generating plant.

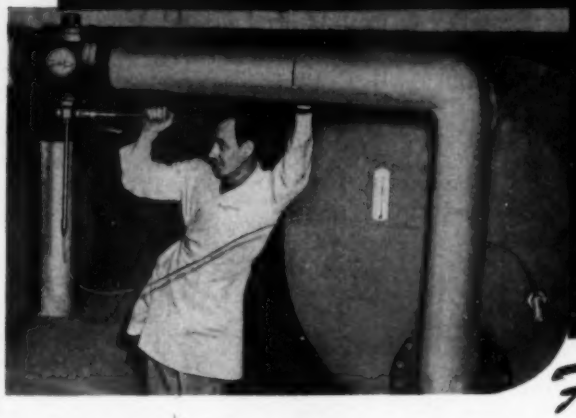
Sales and Project Engineers
THE THERMIX CORPORATION
GREENWICH, CONN.

Canadian Affiliates: T. C. CHOWN, LTD.
1440 St. Catherine St. W., Montreal 25, Quebec
50 Abell St., Toronto 3, Ontario

Designers and Manufacturers
PRAT-DANIEL CORPORATION
EAST PORT CHESTER, CONN.

Hold Everything!

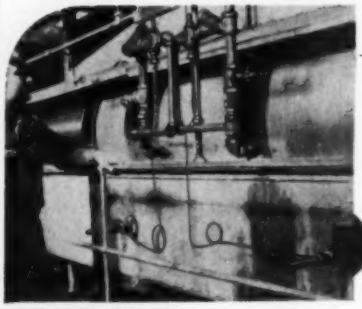
AT CORRECT TEMPERATURES WITH SARCO **TR-21** REGULATORS



HOT WATER

For 20 Years

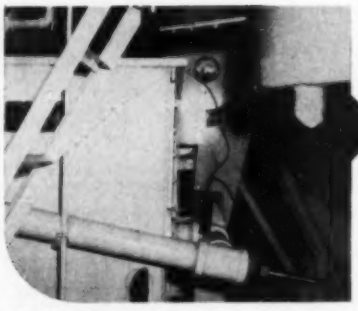
The hot water in this large hotel was held at exactly the right temperature with the Sarco TR-21 regulator illustrated. During all this time there were no complaints because the water was too hot or too cold; and, of course, no heat wasted. Recently a wrench was put on the regulator for the first time and a few dollars worth of new parts installed. Now they look forward to twenty more years of service and saving with Sarco.



PROCESS TANKS

Better Production

No process requires closer regulation than the various tanks in an automatic plating machine. In the plant illustrated, everything is automatic because all temperatures are controlled to within a few degrees by Sarco. The owner reports greatly increased production with practically no rejects and a considerable reduction in the amount of steam used.



CAN COOLING

Production Speed-Ups

Here is a can cooling operation which moves warm cans of fruit through a cooler on a conveyor. When operated by hand, water was wasted to be sure the temperature was safe. Even then, cans sometimes came out too warm and food was wasted. Now, with the same TR-21 regulator shown above, less water is used and no food lost. Ask for Sarco Catalog No. 600.

320

SARCO COMPANY, INC.

Represented in Principal Cities

Empire State Building, New York 1, N. Y.

SARCO CANADA, LTD., TORONTO 8, ONTARIO

SARCO

SAVES STEAM

IMPROVES PRODUCT QUALITY AND OUTPUT

Cochrane Acquires Pottstown Metal Products Co.

COCHRANE CORPORATION, Philadelphia, manufacturers of water conditioning equipment and steam power plant specialties, announces the acquisition of POTTSTOWN METAL PRODUCTS COMPANY, Pottstown, Pa., which will be operated as an independent subsidiary of the Cochrane Corporation. Organized in 1927, Pottstown Metal Products Company has been one of Cochrane's principal sources for steel heater, softener and filter shells and for numerous weldments.

T. E. MC BRIDE, president of the Cochrane Corporation, becomes president and treasurer of Pottstown Metal Products, V. A. ROHLIN is vice president, RAYMOND A. PIERSOL is vice president and general manager, and GEORGE MEASE is plant superintendent.

◆

N.I.S.A.—San Antonio

The Southwestern Chapter of the NATIONAL INDUSTRIAL SERVICE ASSOCIATION met at the Plaza Hotel, San Antonio, Texas, in December to discuss plans for the national convention.

The Plaza Hotel will be the site of the convention, to be held April 15-18, 1951. It is expected that several hundred electric motor repair shops will be represented there.

The convention technical program is based on the theme, "Buy and Sell, Produce and Profit." A popular feature of the program, the round table discussions and forums, will be continued on two afternoons.

A broad variety of exhibits will, as usual, be given a prominent place. These examples of latest equipment, supplies and accessories are always a drawing card at national conventions.

The banquet speaker will be FRED SMITH, Vice President, Industrial Relations, THE WILLIAM POWELL CO., Cincinnati.

Committee chairmen who have been named are: Registration—J. S. T. MCDOWELL, Longview, Texas; Publicity—LEO GLYNN, Houston, Texas; Information—A. H. BARRERE, JR., Lake Charles La.; Entertainment—GUS LIEBER, Shreveport, La.; Reception—PAUL LOYD, San Antonio, Texas; Transportation—J. E. HARDY, Dallas, Texas; Program—JOHN YOUNG, Lubbock, Texas.

G. E. JONES of Amarillo, Texas has been named General Chairman, with FRANK FOSHEE of Fort Worth and CLARK PHIPPEN of Beaumont, Texas, as vice chairmen.

We'll Mail You
THIS VALUABLE MAINTENANCE AID
24 PAGES CLEARLY ILLUSTRATED
IS IT WORTH IT?
For Practical Men
This little booklet covers insulation resistance testing in simple language; packed tight with maintenance hints
JAMES G. BIDDLE CO. ELECTRICAL & SCIENTIFIC INSTRUMENTS

Booklet on Insulation Resistance Testing Answers these questions:

"What is insulation?"
"What makes it go bad?"
"How to test it?"
"Is testing worthwhile?"

"*For Practical Men*" is packed tight with maintenance hints such as—How to Spot Trouble Fast—The Importance of Keeping Records, etc. Purposely written in non-technical language, this booklet received practically unanimous approval in a recent survey. Respondents claimed it was most helpful to them in their electrical maintenance work. Many requested extra copies to pass along to their associates.

If you haven't sent for your copy—or if you want more copies—we'll gladly fill your request by early mail. Thousands have been distributed.

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SP

Presenting the new

REPUBLIC Electronic

FEATURES

NO DEAD SPOTS OR LAGS

The TELEMASTER operates on a null-balance principle with a constant check-back between the initial input and final output, with no intervening mechanisms to cause dead spots or lags. This balance type detection of any deviation in the desired operating conditions, produces a highly responsive and fast acting control system

ELIMINATES PANEL PIPING

No control panel piping is necessary with the REPUBLIC TELEMASTER. Easily installed, multi-wire cables are the only connection between the TELEMASTER benchboard and the plant measuring and control elements. Results? Easier, faster and better appearing installation, increased flexibility, economy, and reduced maintenance.

GREATER APPLICATION FLEXIBILITY

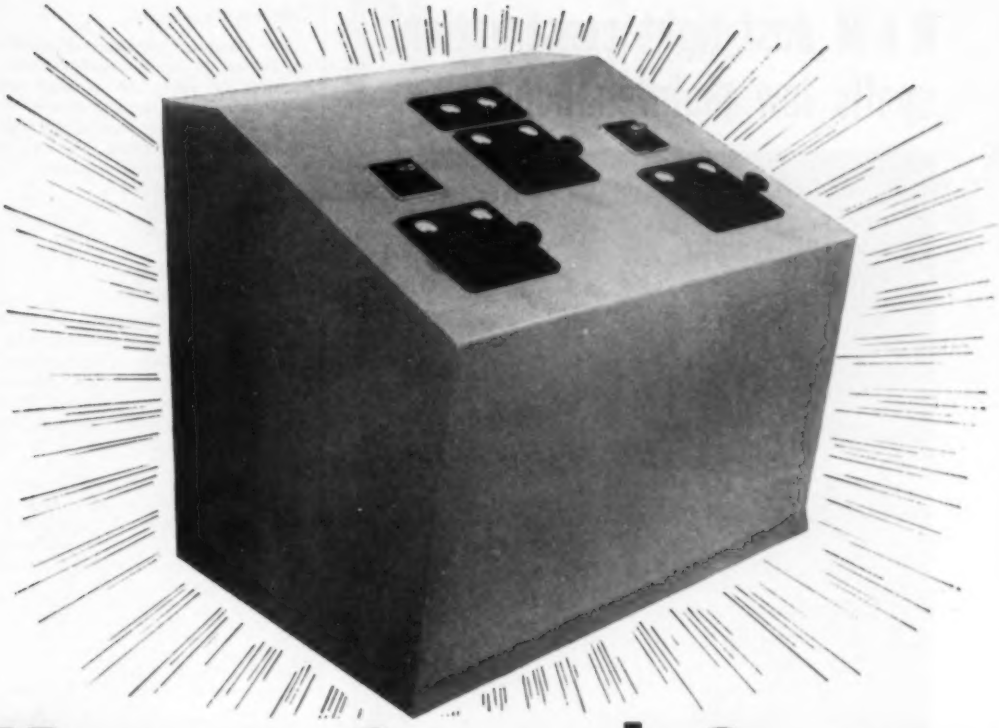
Flexibility required for complete centralization of controls at a central focal point is a distinct feature of the TELEMASTER. The system may be operated under completely automatic, semi-automatic, or manual control from a central supervisory station.

PLUG-IN INTERCHANGEABLE PARTS

Due to simplicity, compactness and interchangeable component parts the TELEMASTER provides a more flexible control system and a more condensed panel area than previously possible. All parts subject to replacement are mounted on compact plug-in units that are easily interchanged and replaced with spare parts.

REDUCED MAINTENANCE

Control room maintenance is sharply reduced. No moving parts or mechanisms are mounted on the control panels. Panel equipment is smaller and less cumbersome, no panel piping is used. Plug-in replacement parts may be installed in a matter of seconds. All components of the TELEMASTER are fully tested and proven for prolonged trouble free service.



Master Control System

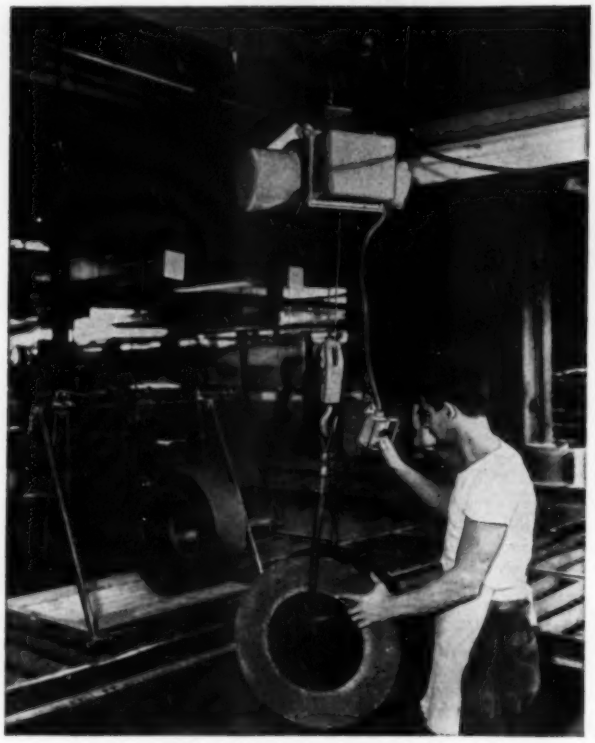
"TELEMASTER"

The new Republic Electronic TELEMASTER Control represents a major advance in the field of automatic control. The TELEMASTER will remotely reproduce, instantly and accurately, a position or a force—perform arithmetical and algebraic calculations—and can be used for multiple operations. Essentially it performs the function of a mechanical link through electrical and electronic means. It is applicable to all types of combustion and process control.

In plants where distances between operating units are great, the lags inherent in the compression effect of a pneumatic master system are appreciable. This effect is frequently sufficient to prevent realization of the full benefits of automatic control. The Republic Electronic TELEMASTER Control has no inherent lag, regardless of distance. This means that centralization of operations can be achieved without any sacrifice of control performance. *Full details sent upon request.*

REPUBLIC FLOW METERS CO. ● 2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

R & M dust-tight construction spells low maintenance...



for BAY STATE Abrasive Products Co.

of Westboro, Mass., who put five Robbins & Myers "J" hoists in service last June handling grinding wheels through manufacturing operations. Airborne abrasive dust that has kept maintenance costs high on other handling equipment has not been a serious problem for their "J" hoists. The "J" hoist motor, load brake, and control pendant are tightly enclosed; dust and trouble stay out; and "J" hoists stay on the job!

When you have a handling problem involving vertical or lateral travel, or both, and you want to do the job in the most efficient manner, you cannot afford to ignore the sound economics of handling through the air. And for sound practical advice on your specific material handling problems, call in your nearest Robbins & Myers representative. He has the experience to make the R & M equipment you purchase pay a high return on your investment. Write for bulletin No. S21P.

TAKE IT UP WITH

ROBBINS & MYERS INC

MOTORS HOISTS CRANES FANS MOYNO PUMPS

HOIST AND CRANE DIVISION, SPRINGFIELD 99, OHIO

Dampney Co—W. Va.

The Dampney Company of America, Boston 36, Massachusetts, manufacturer of protective coatings for metal, announces the appointment of ALLIED SERVICES, INC., Spring and Bullitt Streets, CHARLESTON, W. VA., as sales and service representative for southern WEST VIRGINIA.

◆

C. H. Wheeler Merges With Ohio Companies

Announcement has been made of the merger of the C. H. WHEELER MANUFACTURING COMPANY of Philadelphia; ECONOMY PUMPS, INC., and KLIPFEL VALVES, INC., both of Hamilton, Ohio. All three companies are widely known as manufacturers of power plant equipment.

No change in personnel or operation of any of the companies is planned at the present time. Parent corporation of the three companies is HAMILTON - THOMAS CORPORATION, Hamilton, Ohio.

◆

Dallett Pneumatic Tools Manufactured by Cleco in Houston

THE DALLETT COMPANY of Philadelphia, which was purchased in 1947 by the REED ROLLER BIT COMPANY, has been moved to the CLECO DIVISION PLANT in HOUSTON, TEXAS, where production of Dallett tools and accessories is now in progress.

The combined facilities of the Reed Roller Bit Company in Houston cover 42½ acres of land with over 1,000 modern machine tools and over 542,-255 square feet of floor space.

◆

R-S Products Corp Purchased

Purchase of the R-S PRODUCTS CORPORATION of Philadelphia by S. MORGAN SMITH Company of York, Pa., hydraulic turbine and valve manufacturers, has been announced by Beauchamp E. Smith, president.

Mr. Smith announced that the present management of R-S Products Corporation, W. E. Borbonus, president, and D. W. Hopkins, executive vice president, will be retained along with the present five-man board of directors. The S. Morgan Smith Company will provide two additional members of the R-S board, Burwell B. Smith, vice president, and Duncan D. McArthur, secretary, respectively, of the parent company. There will be no change in the operation of the Philadelphia concern.

Planning more capacity?

figure on aluminum and you'll figure low

When you add feeders, plan new production lines or wire for heavier loads, get prices both ways. Figure in aluminum and in copper. You'll find you can make worth-while savings with aluminum . . . and installation is faster, easier, due to aluminum's light weight.

Although the rearmament program prevents unrestricted sale of aluminum and copper, we are ready to help you with the planning required for projects involving electrical wiring.

FREE "QUESTIONS AND ANSWERS" BOOK on installation of insulated aluminum conductors. Write for it now—ALUMINUM COMPANY OF AMERICA, 1773B Gulf Building, Pittsburgh 19, Pennsylvania.

Insulated **Aluminum Conductors**

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of ALCOA EC ALUMINUM are made by leading manufacturers

TAKE A DART APART!
you'll see at once why DARTS are your best buy!
To get top resistance to stress and stretching, we've made body and nut of high-test, air-refined malleable iron.
Special oscillating grinders give these non-corroding bronze seats a true bearing surface.
Extra width of seats ensures a drop-tight joint without excessive wrenching.
No danger of deforming or stripping with full, clean-cut threads like these.
It's an extra heavy nut so it'll easily shrug off careless wrenching.
No wonder you can use Darts again and again — always count on them for extra service at lower costs.
DART
DART UNION COMPANY
PROVIDENCE 5, RHODE ISLAND
THE FAIRBANKS CO. — Distributors
Boston • New York • Pittsburgh

Eriez Manufacturing Co.—Charleston, W. Va.

THE ENGINEERING PRODUCTS COMPANY, of CHARLESTON, WEST VIRGINIA, has been appointed sales representative for the full line of Eriez magnetic separation equipment. This includes all permanent magnetic separators made by Eriez, as well as RCA Electronic Metal Detectors. The announcement was made by R. A. Roosevelt, Sales Manager, ERIEZ MANUFACTURING COMPANY, Erie, Pa.

GEORGE GARRETT, Electrical Engineer and former Chief Engineer for E. I. du Pont de Nemours, and RALPH CRUMP, Mechanical Engineer, are members of the sales force for Engineering Products Company, with F. E. ANDERSON, Chemical Engineer, as General Manager.

◆

Ladish—Tulsa and St. Louis

LADISH CO., Cudahy, Wisconsin, manufacturer of a complete line of Forged and Seamless Welding Pipe fittings has announced the establishment of a branch office at 405-406 Thompson Building in TULSA, OKLAHOMA. The office is under the managership of G. E. MAHONEY who for the past 3 years has served as District Manager for Ladish at Chicago.

Simultaneously Ladish announced a change in address of their ST. LOUIS office and the appointment of W. H. HECKENBERG as District Manager. The new office address is Suite 1605, Continental Building, 3615 Olive Street, ST. LOUIS, MISSOURI.

◆

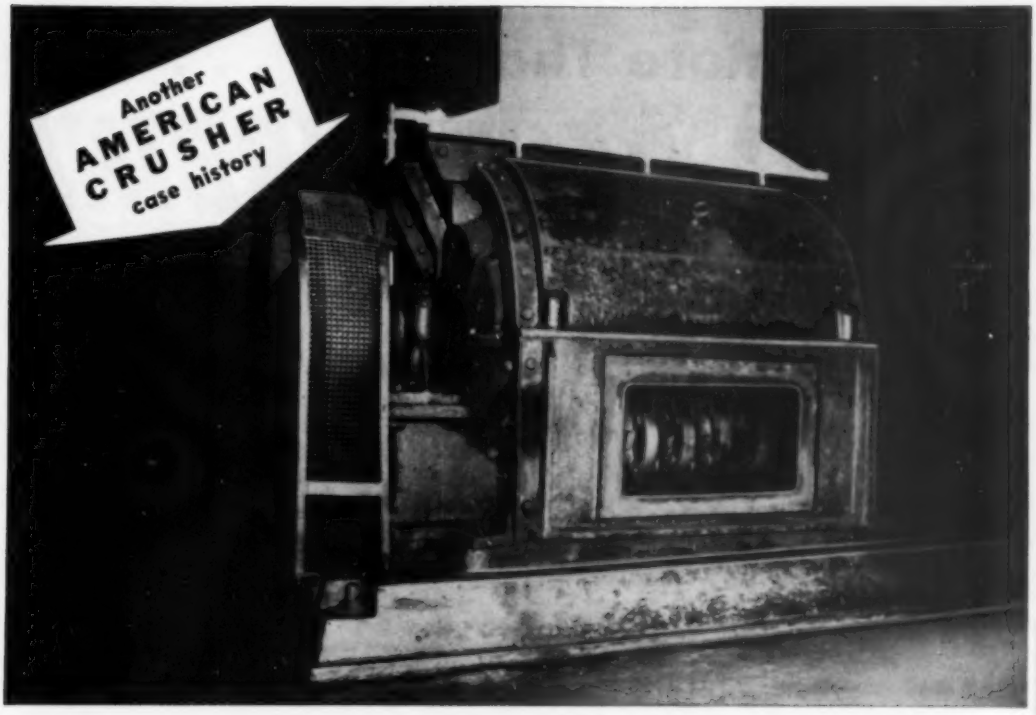
TCI—Birmingham

ROBERT GREGG retired as president of the TENNESSEE COAL, IRON AND RAILROAD COMPANY of BIRMINGHAM, ALABAMA effective January 1, 1951, and has been succeeded by ARTHUR V. WIEBEL, formerly vice president in charge of operations it was announced recently.

Also announced by the steelmaking subsidiary of UNITED STATES STEEL CORPORATION was the election of JOHN PUGSLEY, now comptroller, to the newly established position of executive vice president.

Succeeding Mr. Wiebel as vice president in charge of operations is J. M. SPEARMAN, who advances from the position of manager of manufacturing operations.

Mr. Pugsley's successor as comptroller will be HARTWELL A. GREENE, presently assistant comptroller.



20 years --- and 6,000,000 tons later: STILL GOING STRONG

Yes, over 2 decades ago this American Crusher 42S was installed in a New Jersey Central Station. Since then, it has continuously and faithfully crushed more than 6 million tons of coal.

But here is the eye-opening part of this enviable record: during this entire 20-year period, the total parts replacement cost per ton of coal crushed has been only $.00025. (In other words, 40 *tons for a penny*).

Even more convincing proof of American Crusher *quality* is the fact that this is a *typical case history*—not an isolated example. An extensive independent survey has revealed over and over again that Americans consistently produce high tonnage for years —at amazingly low parts-cost figures. Discover for yourself why Americans are preferred everywhere for performance, for dependability, and for economy of operation.

WRITE for special "AC Coal Crushing Bulletin"

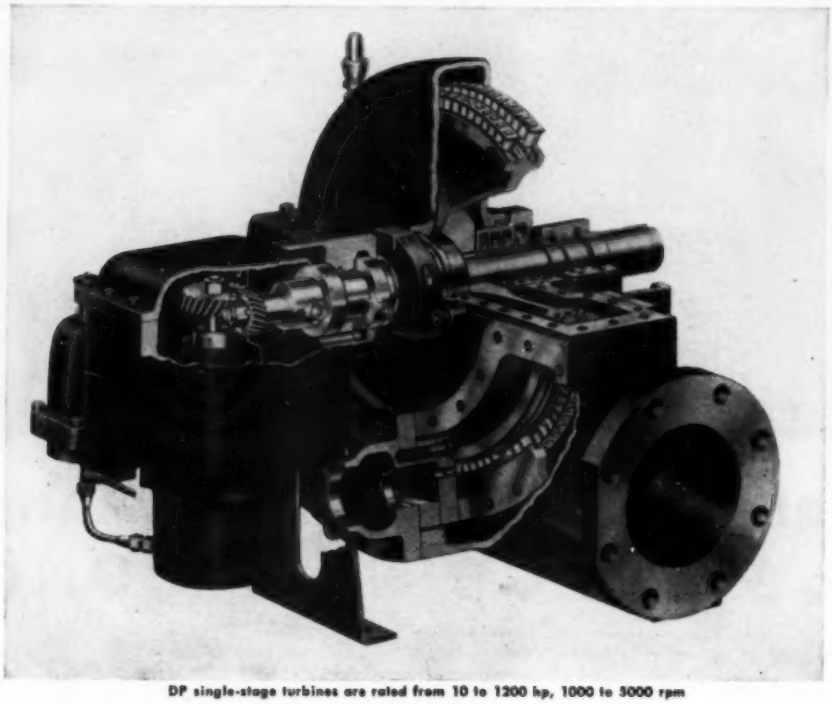
American PULVERIZER COMPANY

Originators and Manufacturers of Ring Crushers and Pulverizers

1243 MACKLIND AVE.
ST. LOUIS 10, MO.

Now More Than Ever . . .

YOUR BEST TURBINE



DP single-stage turbines are rated from 10 to 1200 hp, 1000 to 5000 rpm

Type

DP

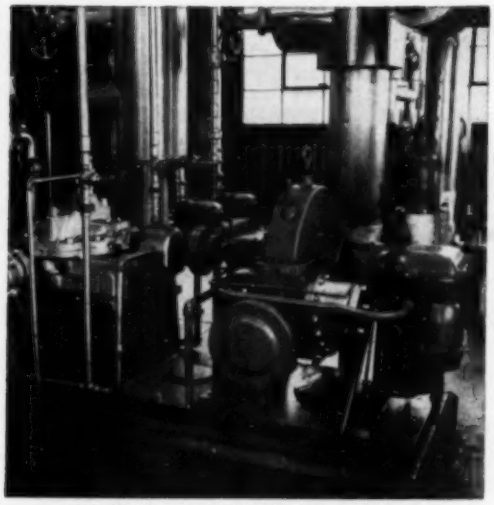
Since the introduction of the DP turbine, more than two years ago, General Electric has been telling mechanical-drive turbine users that their best turbine buy was a *standard* design, wherever it could be properly applied. Nowadays, with the emphasis on increased output, the advantages which turbine standardization offers are even more important.

Standardization means that turbines of different rating and size have mostly identical construction features. This speeds delivery, cuts manufacturing costs, makes possible a better design and a better turbine. If you're not familiar with the General Electric DP, we suggest that you contact your nearest G-E sales office or send for a copy of bulletin GEA-4955, "A New Standard in Mechanical Drive Turbines." Write to *Apparatus Dept., General Electric Company, Schenectady, N. Y.*

GREATER RELIABILITY

From its totally enclosed governor to its durable babbitt-faced bearings, General Electric's DP turbine is built to provide greater productivity through greater reliability. Standardization has made possible "extras" such as pressure lubrication, Monel-sprayed shaft, self-positioning packings, a totally enclosed hydraulic governor. You can count on your DP for safe, dependable service in hazardous atmospheres and on tough, continuous-process assignments.

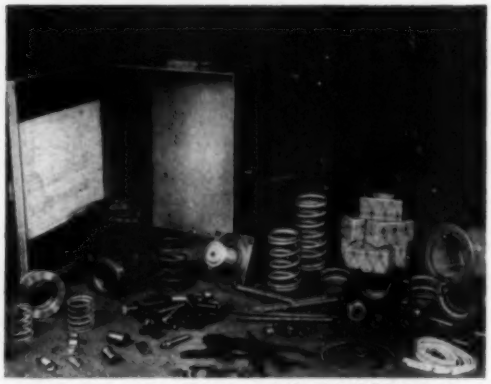
DRIVE IS A STANDARD.



This DP drives a centrifugal pump in a refinery

WIDE APPLICATION FLEXIBILITY

In plants which require shifting of equipment from job to job, a standard DP frequently eliminates the need for extra drives. Because most parts are identical for all ratings, speed range and shaft horsepower can be easily and economically changed to fit new conditions. Though the DP's 30% adjustable speed range is usually adequate, a new range can be set anywhere from 800 to 5000 rpm simply by substituting a new emergency governor and governor gears. A change in horsepower rating usually requires a new nozzle plate and a few valve parts. These parts are all available on immediate delivery and save the expense of a new turbine which would be required with a less flexible, non-standard unit.



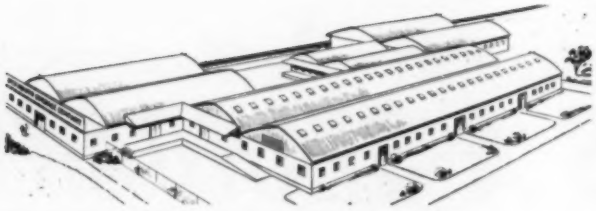
Standard spare parts kits are available with all DP turbines

EASIER, QUICKER MAINTENANCE

Because most parts of standard DP's are interchangeable on all models, spares can be easily stocked, and maintenance work handled quicker. You can have delivered with the turbine a 91-item spare parts kit, sufficient to service several machines. Socket-head cap screws are used throughout for quick disassembly. Standard shaft height, keyways, and coupling fits simplify installation. You can move DP's from job to job without change in the base structure.

GENERAL ELECTRIC

253-49



Plymouth Cordage—New Orleans

THE PLYMOUTH CORDAGE COMPANY, Plymouth, Mass., has purchased a 21½ acre site in NEW ORLEANS, LOUISIANA, for the erection of a cordage mill. All New Orleans production facilities will be moved to the new 155,000 sq ft plant. Facility will employ approximately 125.

Types of cordage to be made include manila and sisal ropes, tying twines, binder and baler twine.

At the present time the company leases a building at 1101 South Peters Street, New Orleans. Construction of the new plant is expected to be under way early in 1951.

Pointsett Addition—Pickens, S. C.

THE POINTSETT LUMBER AND MANUFACTURING COMPANY of PICKENS, S. C., has construction under way on a 20,000 sq ft addition to their present plant. The $150,000 project includes a pump house and a considerable amount of regrading, for the purpose of making way for future expansion.

The Pointsett Lumber and Manufacturing Company is a subsidiary of Singer Sewing Machine Company concerned with the lumbering operations and manufacture of the sewing machine cabinets.

Also under construction for the company is a new plant near ANDERSON, S. C., which will house complete assembly operations for Singer Sewing Machines. The plant is being built by the DANIEL CONSTRUCTION COMPANY of GREENVILLE, S. C.

◆

Farris Appoints D. B. Gooch —Birmingham

FARRIS STACON CORPORATION, Palisades Park, N. J., has announced the appointment of the D. B. GOOCH ASSOCIATES, 8008 First Avenue North, BIRMINGHAM 6, ALABAMA, as representatives for the company. The Birmingham firm will handle the application of temperature regulators.

◆

Fairbanks, Morse—Louisville

FAIRBANKS, MORSE & CO., Chicago manufacturers, announced the appointment of C. G. GEHRINGER as Manager of their branch house located in LOUISVILLE, KENTUCKY.

Mr. Gehringer was graduated from the University of Cincinnati in Engineering, with a CE degree. He joined the Fairbanks-Morse sales organization in September, 1936.

GENERAL
REG. U.S. PAT. OFF.

RODA — High grade gas, by-product, steam and household stoker coal from Wise County, Virginia, on the Interstate Railroad.

DENDRON — High grade gas, by-product, steam and domestic coal from Wise County, Va., on the Interstate Railroad.

STONEGA — High grade, high volatile steam and by-product coal from Wise County, Va., on the Interstate Railroad.

PREMIX — A laboratory controlled product blended to meet exacting stoker requirements. From Wise County, Va., on the Interstate Railroad.

GLENBROOK — The Premium Kentucky High Splint unmatched for domestic use. Produced in Harlan County, Kentucky, on the L. & N. Railroad.

COKE — Roda and Stonega from Wise County, Va.

CRITERION COAL — High grade gas, by-product, steam and domestic coal—Pittsburgh seam from Irwin Basin, Westmoreland County, Pennsylvania, on the Penna. Railroad.

HAMPTON COAL — High volatile domestic, steam and by-product coal from Boone and Logan Counties, W. Va., on the Chesapeake & Ohio Ry.

CROZER — Genuine Pocahontas from McDowell County, W. Va., on the Norfolk & Western Railway.

LYNCO — High fusion coking coal for by-product, industrial stoker and pulverizer use from Wyoming Co., W. Va., on the Virginian Ry.

ANTHRACITE
Hazle Brook—*Premium Lehigh*
Raven Run—*Premium Mahanoy*

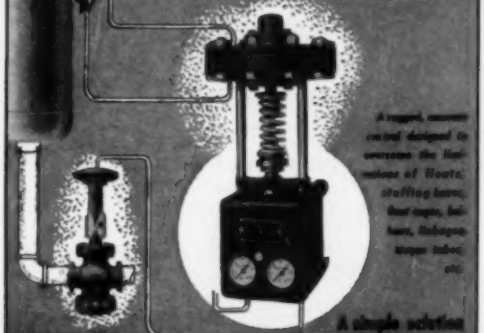
Capable engineering personnel and the experience gained through long and varied marketing activity assure proper application of one of the above brands and effective servicing of any fuel requirement.

General Coal Company
123 SOUTH BROAD STREET PHILADELPHIA 9, PA.
Branches:
BLUEFIELD, W. VA. BUFFALO CHARLOTTE, N. C. CINCINNATI
NEW YORK NORFOLK PITTSBURGH

LESLIE

Floatless LEVEL CONTROL

for BOILERS, TANKS, EVAPORATORS, HEATERS, STANDPIPES, etc.



A simple solution to a troublesome problem

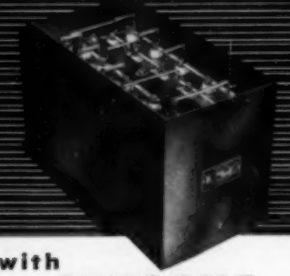
SEND FOR Float-less Level Control booklet

ESTABLISHED 1900 LESLIE CO. 50TH ANNIVERSARY

261 Grant Avenue, Lyndhurst, New Jersey

PRESSURE REDUCING VALVES • • PRESSURE CONTROLLERS
PUMP GOVERNORS • • • TEMPERATURE REGULATORS
SELF CLEANING STRAINERS • • LESLIE-TYFON WHISTLES

CUT POWER COSTS!



with

SPRAGUE

POWER FACTOR CAPACITORS

Lower power bills . . . greater loads from present circuits . . . less wiring, transformer, and switchgear costs in new installations—these are some of the advantages of SPRAGUE "on-the-spot" low-voltage industrial power factor correction capacitors. Write for a free copy of the Sprague Power Factor Correction Guide today and find out how you, too, can save money with Sprague Capacitors.

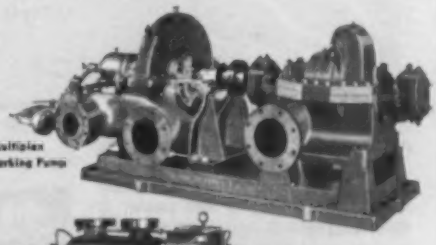
SPRAGUE ELECTRIC COMPANY

NORTH ADAMS MASS.

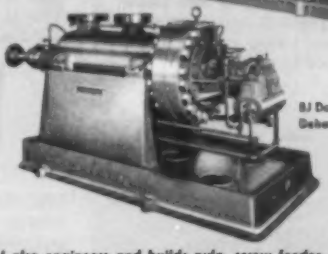
Your debarking PUNCH is only as potent as the pumping MUSCLE behind it...

BJ DEBARKING PUMPS

put real *wallop* into your hydraulic debarking. They have the pressure strength and the operating stamina to work continuously at full bark-blasting efficiency! Multiplex models deliver up to 1600 psi with capacities as required. Double Case models provide pressures up to 2800 psi and capacities to 1 million pounds per hour. BJ Debarking Pumps are engineered to your particular equipment and power set-up. Write for detailed performance data or recommendations on your debarking pumping—without obligation, of course.



BJ Multiplex Debarking Pump



BJ Double Case Debarking Pump

BJ also engineers and builds pulp, screw feeder, and other special centrifugal pumps for pulp and paper applications.

Byron Jackson Co.

Since 1872

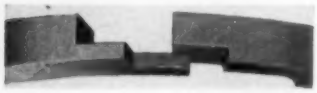
P.O. Box 2017 Terminal Annex, Los Angeles 54, Calif.

NEW EQUIPMENT for Southern Industry

Free additional information is available to readers of Southern Power & Industry. Check item code number on the postage free service coupon post card provided on p. 17.

Piston Ring

C-1 THE DOUBLE SEAL RING COMPANY, Fort Worth Texas, has developed a new piston ring designed to lessen the possibility of the ring catching in a cylinder port. The new device, known as the "Sealock", incorporates a feature which locks one of the ring ends in tightly against the other. The locked end is thus prevented from expanding into ports in a cylinder wall.



The result is said to be greatly reduced ring breakage, and much less wear of the cylinder walls and the ring itself. The tongue is narrower than those on previous models and can be made to fit narrower grooves. Another advantage is full sealing against compression blowby, even when a ring compensates for cylinder wall taper.

◆

Tractor For Small Plants

C-2 THE MARKET FORGE COMPANY, Everett, Mass., is manufacturing a new battery-operated tractor for use in small plants. The tractor is also useful in other applications such as lifting loads by rope and tackle and hauling other types of equipment.

It features 3-way operating positions and may be driven in any of the following ways: the operator facing away from the load he is hauling; the operator facing the load for narrow passages; and riding on the step provided for easy access on and off the truck. This is convenient for short hauls.

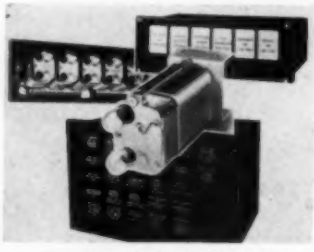
The tractor can be furnished with practically any type of tractor hitch—automatic or manually operated.

Exact specifications are: Models—3000 lb and 5000 capacity; draw bar pull—500 to 800 lb; no load speed—3.5 to 4.0 mph; full load speed—2.5 to 3.0 mph; overall length—44"; overall width—30".

◆

Multiple Unit Signal

C-3 PANALARM PRODUCTS CO., 7218 North Clark St., Chicago 26, Ill., announces the development of its new Panalarm—a back lighted multiple unit signal. The



new Panalarm finds application as a trouble signal in process industries and power plants. It may be used to detect off-normal operation of almost any type of equipment.

It is hermetically sealed unit, combines signal lights and relay in a single sealed container, and forms a complete one-piece unit that plugs into a universal chassis, making it both easy to install and easy to service.

Separators

C-4 THE SWARTWOUT COMPANY, 18511 Euclid Ave., Cleveland 12, Ohio has announced a complete line of separators for use in separating unwanted liquids and solids from steam, air or vapors under pressure or vacuum.

Operating on the helico-centrifugal principle, the separators have a smooth helix that gives the steam or air a positive whirling motion which they run down to a drip pocket. According to the manufacturer, the process takes place with virtually no pressure drop. The positive action of the separators assures that slugs of water will not be carried into the engine or turbine and oil and grease will not spoil work in process or gum up pipes.

The units are made in a variety of styles and sizes. Those made of high tensile cast iron are for use with 50, 125 and 250 lb steam; and those made of cast carbon steel are for use with 150, 300, 400 and 600 lb. Sizes range from 1½" to 24".

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2 = EXACT GRADE
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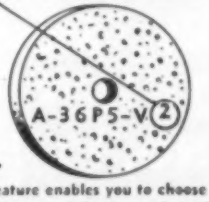

This feature enables you to choose the exact degree of hardness desired by splitting every normal grade into three degrees of hardness, where a whole grade change would be too great.

ADVANTAGES:

- Customer time saver.
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BAY STATE ABRASIVE PRODUCTS CO., Westboro, Mass.
Chicago, Cleveland, Detroit, Pittsburgh • Distributors All Principal Cities

Top Performance Consistently Duplicated

Off Center Relief Valve

C-5 *R-S* Products Corporation, 4600 Germantown Ave., Philadelphia 44, Pa., has developed an off center valve of the disc type which simplifies the control

of 15 psig saturated steam with a low pressure drop. The valve is 8" in diameter and has 150 lb American Standard raised face flanges. A double crank arm with adjustable weights facilitates accurate setting. The cylinder is not an actuator but simply a dash pot. A 2" flanged outlet is provided for overload relief.

These disc type valves are available in smaller and larger sizes and for higher pressures. They are also used in air, gas, liquid and semi-solid service for the control and shut off of volume and pressure.

Steam-Jet Cleaning Unit

C-6 Livingstone Engineering Company, 100 Grove St., Worchester 5, Mass., has announced a new steam-jet cleaning unit known as the Speedyjet.

The unit includes a high pressure detergent tank mounted on a light weight all-metal dolly with rubber tired 10" wheels and handle bar grips for easy portability; also 25 ft of high pressure steam hose for connection to the source of steam and 25 ft each of steam and detergent hose from the tank to the Speedylecric steam lance.

The unit is equipped with pressure gauge, 200 psi safety valve, and control valves. The detergent tank is insulated and enclosed in an enamelled metal case. Speedyjet has many industrial applications for cleaning and sterilizing, wherever steam is available at pressures in excess of 80 psi.

◆

Wire Rope and Rod Cutter

C-7 Manco Mfg. Co., Bradley, Ill., has developed a new line of "Guillotine" wire rope cutters. Hand, air, and electrically operated models for cutting 1" steel rod and chain, 1¼" wire rope, and 3½" power cable, are available.

In order to reduce tool size, 10,000 lb hydraulic pressure is used, with the result that a 60,000 lb thrust is developed in a portable package. The performance is equivalent to a 30 ton punch press.

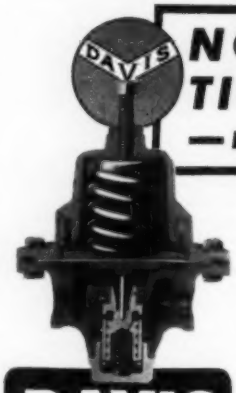
The 39 lb model Guillotine with a 1" steel rod capacity is hand operated and completely self-contained. Similar in design is the 45 lb model, also hand operated, with a 1¼" wire rope

capacity. A third model for hand cutting 3½" power cable is also in the 45 lb weight class.

For power operation the above units are adaptable to a 12 lb air hydraulic pump or 80 lb electric hydraulic pump. For production cutting a high speed hydraulic pump using a 2 hp electric motor or 5 hp gasoline engine is available.

FREE READER SERVICE

To obtain free information on this equipment, circle number on the page 17 free post card.



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Single seated, tight closing, non-sticking. Large diaphragm, sensitive pressure adjustment. Compact, rugged, self-contained.

TROUBLE-FREE SERVICE—
Built-in strainer, finest quality, all internal parts accessible and renewable without disturbing piping.

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Chrome Plating Device

C-8 WARD LEONARD ELECTRIC CO., Industrial Chrome Division, Mount Vernon, N. Y., has developed the "Chromaster" to provide production industries with complete facilities for hard chrome plating metal surfaces up to 10 sq in. at the recommended current density of 2 amp per sq in. Unit is compact and portable.

Powered by a dry disc, power pack, selenium rectifier, the unit is complete with plating bath tank, heavy duty rheostat, timer, ammeter and reversing switch for stripping action. The hard chrome deposition can be controlled to tolerances of less than 0.0001".

The manufacturer is also producing "Chromasol", a new non-critical chrome plating solution operating at room temperature, and shipped to the user in a liquid, concentrated form. The product delivers a hard chrome plate that follows the characteristics of the base metal to which it is applied. The rate of deposition remains constant at 0.002" per hour.

Using this process 1½ minutes is the average time required to hard chrome cutting tools and wear parts and fortify them against chip-loading, galling actions and heat wear.

◆

Fire Protection

C-9 WALTER KIDDE & COMPANY, 40 East 34th Street, New York 16, N. Y., has developed fire extinguishing equipment with directional valves to make it possible for several plant hazard areas to be protected with a single source of extinguishing agent. Storage cylinders are manifolded together for simultaneous discharge. The cylinder bank can be arranged in groups, so that each hazard can be protected by an initial discharge group and a reserve discharge group of cylinders. Typical hazards encountered are deep-seated fire (in record storage); electrical fire in control room; and flammable liquid fire in oil storage. The new system provides a carbon dioxide discharge line and a fire detector connecting line to each hazard area.

When the detector picks up the first signal of fire it actuates the directional valve controlling the group of cylinders guarding that space. A mechanical linkage opens the release valves on the heads of these cylinders. Under its own power, the carbon dioxide rushes through the discharge piping and is discharged as an inert gas from the nozzles.

FREE READER SERVICE

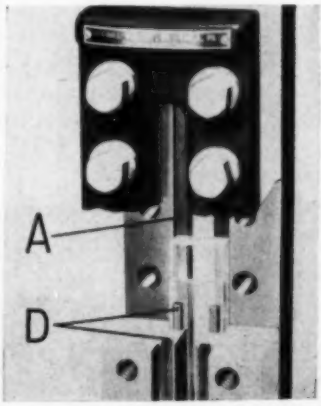
To obtain free information on this equipment, circle number on the page 17 free post card.

◆

Water Level Gage

C-10 YARNALL-WARING COMPANY, Mermaid Lane, Philadelphia 18, Pa., is now producing flat glass inserts fitted with improved gaskets coated with special compound that prevents adhering to the gage metal surfaces under high pressure and high temperature service, which may be used when glasses or gaskets of high-pressure water level gages are replaced. This Yarway Frelon gasket is the molded pressure-sealed gasket (D) located in the grooves of the gage insert body.

Illustration shows other details of the Yarway pressure-sealed "floating assembly" flat-glass water level gage. Water gage Bulletin WG-1811 and further information on these Frelon gaskets are available from the manufacturer.

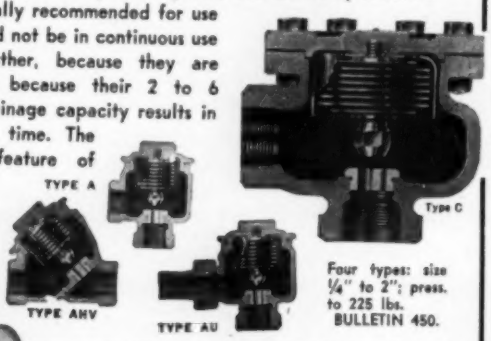


Nicholson Makes

Freeze-Proof Steam Traps

for Every Plant Use

Because they drain completely when cold, these four types of Nicholson steam traps are positively freeze-proof. Can be freely installed outdoors. Universally recommended for use in lines which need not be in continuous use during cold weather, because they are freeze-proof and because their 2 to 6 times average drainage capacity results in minimum heat-up time. The non-air-binding feature of Nicholson traps also notably facilitates steam transfer in severe weather.



Four types: size ¼" to 2"; press. to 225 lbs. BULLETIN 450.

HIGH-PRESSURE FLOATS—Stainless, monel, steel or plated steel. Welded. In all sizes and shapes; for operating mechanisms and as tanks or vessels. 2-day delivery. BULLETIN 650.

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Ernest E. Norris
President

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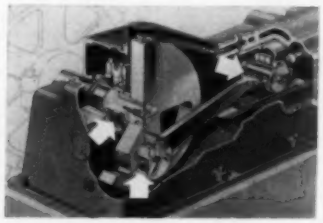
SOUTHERN RAILWAY SYSTEM

Motor-Driven Compressors

C-11 CHICAGO PNEUMATIC TOOL COMPANY, 6 East 44th St., New York 17, N. Y., has developed a pneumatic horizontal duplex motor-driven compressor with anti-friction roller bearings throughout. Spherical roller main bearings support the crankshaft and are also used in the crankhead end of the connecting rod.



A simple hydraulic pump is used in the oil injection method to inject oil between the bearing or crank disc and tapered shaft. The oil pressure expands the part inner bore and the oil film reduces friction between the parts as the pressure separates the contacting surfaces; this friction loss and resultant axial component of force causes the crank disc or bearing to pop off the shaft. Parts are installed in the same manner. After a part is positioned on the shaft the oil pressure is released and contact is restored.

◆

Steam Spraying Equipment

C-12 KELLOGG DIVISION of AMERICAN BRAKE SHOE COMPANY, 97 Humboldt St., Rochester 9, N. Y. has introduced a complete line of equipment for spraying paint with steam, including a new spray gun using superheated steam instead of compressed air.

The use of dry, superheated steam as an atomizing medium serves to heat the finishing material, making it possible to use materials of higher viscosity. This allows the application of heavier coats without sagging or running. The difficulties of pinholing or popping, normally caused by entrapped air, are reduced.

A source of steam of not less than 100 psi is required for operation. If plant steam is unavailable this may be furnished by a small steam generator. Appropriate steam spray guns, separators, strainers, traps and regulators are needed, as well as a superheater to dry the steam by raising it to the proper temperature.

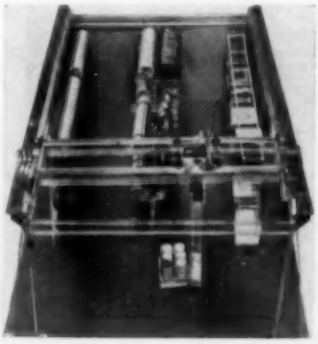
FREE READER SERVICE
To obtain free information on this equipment, circle number on the page 17 free post card.

The steam spray gun was developed to meet the unusual requirements of steam spraying. New insulation and radiation design features dissipate the heat caused by the steam in the gun. Hose supports for steam and materials reduce the downward torque on the spray head. Other features include a built-in finger guard, an adjustable fluid needle, and a spray head with one piece, easy-to-clean steam cap and fluid nozzle.

◆

Selective Storage System

C-13 CHICAGO TRAMRAIL CORPORATION, 4000 West Washington Blvd., Chicago 24, Ill., has developed a new method of storing materials to provide selectivity in handling any item of any size or shape. It is adaptable to such objects as rough stock, pallets, rolled goods,



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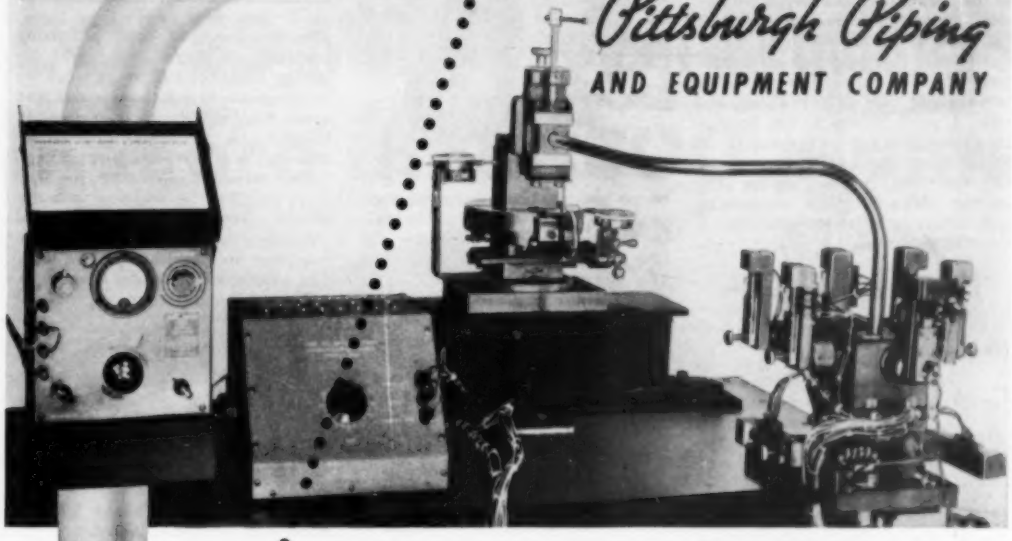
STERLING ELECTRIC MOTORS

Plants: New York 51, N. Y.; Los Angeles 22, California; Hamilton, Canada; Santiago, Chile.
Offices and distributors in all principal cities.

Model Testing at Pittsburgh Piping AND EQUIPMENT COMPANY



The Modern Method for Complete, Practical Pre-determination of Piping Flexibility

Model testing is one of the many technological advancements thoroughly investigated and proved by Pittsburgh Piping and Equipment Company before being made generally available. It provides complete advance knowledge of the reactions of any type, size, and system of power piping.

The testing apparatus shown above accurately measures and directly indicates the physical reactions of a section of pipe which exactly duplicates, in miniature, the planned layout. These measurements are projected to give precise information on the full size system as a check against theoretical calculations.

On complex piping layouts, model testing provides a complete analysis instead of theoretical approximation; it is a time and labor saver; and the possibility of mathematical error is minimized. Its use helps to avoid excessive stresses, reactions, and movements in the final system which could affect joints and thus cause leakage, or damage anchors and equipment connected to the pipe line.

Look to Pittsburgh Piping and Equipment Company for leadership in methods that assure greatest safety, highest efficiency, and longest service from high temperature, high pressure piping.

Model Testing makes possible the planning of high-pressure, high temperature piping systems with accurate advance knowledge of end reactions, stresses, and strains encountered in actual operation.

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drums, bundles, dies, patterns, and other items.

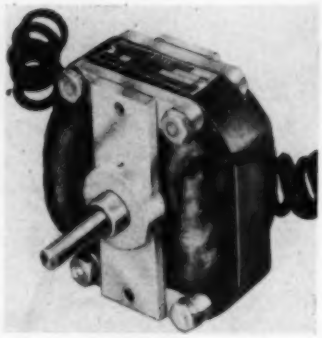
The new system consists of self-standing rack-columns designed to receive the required material, and arranged on either side of narrow aisles. A crane bridge spans the entire width of the storage area and travels lengthwise on tracks to any depth. It is equipped with an overhead trolly from which is suspended an electric fork lift. The fork lift revolves to serve either side of the aisles, and with a push button in his hand a single operator can control any or all motions required to place or remove any item from its place on the rack in any aisle. Complete engineering and design facilities are provided by the manufacturer.

◆

New Motor Design

C-14 THE ELECTRIC MOTOR CORPORATION DIVISION of HOWARD INDUSTRIES, INC., Racine, Wis., has recently redesigned and improved their model 800D shaded pole motor, rated 1/200 to 1/80 hp.

The model is a four pole, skeleton type fractional horsepower motor designed for building into products



whose housings make a separate motor unnecessary. Redesign of the bearing bracket has achieved greater rigidity and more accurate alignment. The motor is available with either porous bronze bearings with generous oil reservoir or grease sealed precision ball bearings. Gear reducers and cooling fans are also available.

◆

Cut-Out Couplings

C-15 ANCHOR STEEL & CONVEYOR COMPANY, 6906 Kingsley Ave., Dearborn, Mich., is manufacturing a new automatic device for machine tools, processing equipment, conveyors, etc., which instantly shuts off the power when an overload due to any cause occurs, and resets itself automatically, preventing sheared pins and saving time normally required to replace them.

The new device combines the features of a flexible coupling with the torque - sensitive protection of the company's cut-out pulley. The cut-out couplings are furnished in two sizes and with working ranges from 10 to 2,000 inch pounds torque.

FREE READER SERVICE

To obtain free information on this equipment, circle number on the page 17 free post card.

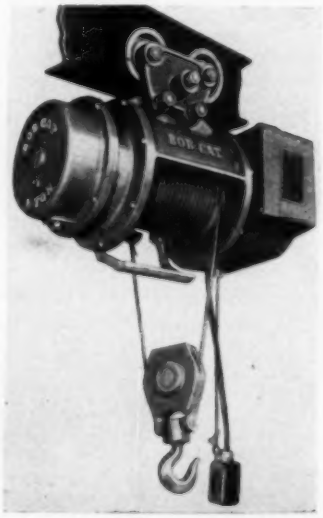
◆

Electric Cable Hoists

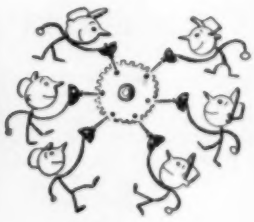
C-16 THE CLEVELAND CHAIN & MFG. CO., Broadway and Henry Streets, Cleveland 5, Ohio, has announced a new line of heavy duty electric cable hoists.

The hoists are manufactured in ½, 1, 1½, 2, 3, and 5-ton capacities. An outstanding feature is the total enclosure of the motor within the cable drum, reducing over-all dimensions and affording substantial weight savings. Motors are protected against moisture, splashing liquids, weather, dust, and corrosive atmosphere.

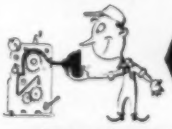
Hoists are powered by high torque Ohio motors. Gear reduction is by means of a double internal gear train



Manzel
AUTOMATIC FORCE FEED LUBRICATION
Gives each wearing point a full-time 'oiler'



Frees manpower for more productive jobs.



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LOOK at the record. More than 1300 plants depend on COPES Multi-Element Regulators for accurate feed-flow and water-level control on their fast-steaming high-duty boilers. Some use the COPES Balanced Flow, actuated by steam flow, feed flow and water level. Others use COPES Flowmatic, the most widely used two element regulator. Let this wide experience help you operate your boilers more safely, more efficiently. May we show you how?

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WHAT'S THE BEST WAY TO STRIP PAINT FROM METAL PARTS TOO LARGE TO BE SOAKED IN TANKS?
See Page 3

Oakite's New FREE Booklet on Paint Stripping

answers many questions that will lead you to better stripping procedures. You'll want to read more about:

What's the best way to strip large areas of structural metal where a steam supply is available? *See page 5.*

What is the best method when steam is not available? *See page 7.*

What is the cheapest way to strip metal parts in large volume? *See page 9.*

What are the best ways to prepare stripped surfaces for repainting? *See page 11.*

What strippers are best for removing oil-base paints? . . . Synthetic enamels, alkali-resistant plastics or resin-based paints? . . . Japans, wrinkle finishes, nitrocellulose lacquers, alkyds, phenolics and ureas? *See page 12.*

FREE For a copy of "How to STRIP PAINT" write to Oakite Products, Inc., 23A Thames St., New York 6, N. Y.

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that incorporates two Weston-type load brakes. Motor brake is of the equalizing solenoid type connected to an up-limit cutoff switch.

Load lifting and carrying parts are made of steel forgings and castings. Load hook oscillates on ball bearings and swivels on roller bearings. Designed for operation on 220, 380, 440 or 550-volt 3-phase, 60-cycle current, the hoists are available with either pendant rope control or push-button control on pendant cable. A transformer in the electrical supply line cuts voltage at the control to 110 volts.

◆

Crankshaft Alignment Indicator

C-17 BEEKMAN INDUSTRIES, INC., Graybar Bldg., 420 Lexington Ave., New York 17, N. Y. announce the availability of a new crankshaft alignment indicator. The instrument is designed to protect the engine from mechanical breakdown caused by fractured crankshafts, usually attributable to faulty crankshaft alignment.

The indicator is suitable for use on all types of gasoline, diesel, and dual-fuel engines of any make.

Specifications: Dial type, graduated in 1/1000ths, plus or minus 25, with 3 extension rods and 7 distance pieces with pointed ends and in graduated lengths, which when assembled in the required combination will handle a range from 2¼" to 18" between crankshaft webs.

◆

Induction Motors

C-18 ELECTRIC MACHINERY MFG. COMPANY, Minneapolis, 13, Minn., has announced a new line of heavy duty, wound-rotor induction motors. These motors provide variable speed drive, and are also advantageous on applications requiring high starting torque and low starting current, or long acceleration periods.

Built in ratings from 30 to 1500 hp, drip-proof construction is furnished as standard on these motors. Splash-proof or enclosed, forced ventilation, models are also available. The heavy duty, fabricated steel frame is said to feature high physical impact strength and crack-proof steel-bar feet. The motors are available with either ball or split-sleeve type bearings to provide long wearing qualities, and are easily accessible for inspection and maintenance. Brush pressure is adjusted with a ratchet wheel brush tension which provides metered increase or decrease of pressure on the individual brushes.

◆

Gravity Feed Oilers

C-19 TRICO FUSE MFG. CO., 2948 North 5th St., Milwaukee 12, Wis., has announced the availability of new large capacity gravity feed oilers in 10 oz, 1 pint, 1 quart, and 2½ quart capacity Pyrex glass or Lucite plastic reservoirs, with lock ring or ratchet feed adjustment designed to feed any pre-determined number of drops per minute.

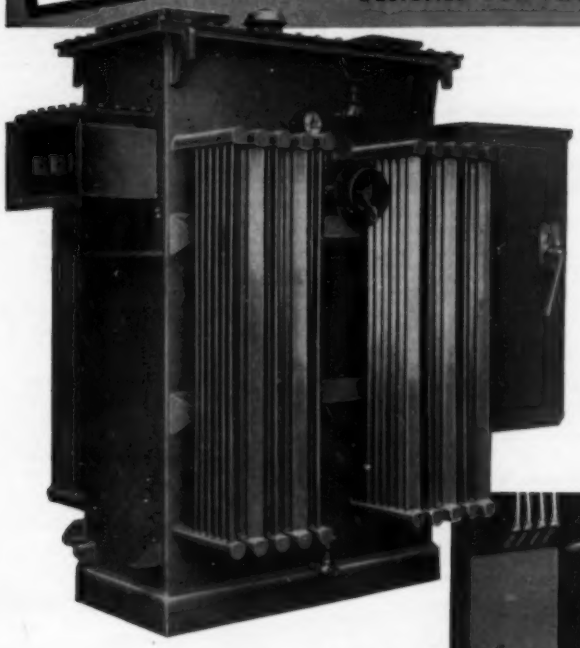
The manufacturer recommends the new oiler for application on large stationary bearings, machinery, journals, conveyor drive chains, and wherever a large quantity of oil is required or when it is desirable to extend reservoir refilling time as long as possible.

Rate of feed is obtained by regulating a simple needle valve control. Setting is firmly locked in place. When shutoff lever at top of oiler is in upright position, oiler feeds at the set rate. Oilers are provided with Pyrex glass or Lucite plastic sight feed fittings, with standard threads for mounting directly on top of bearing or part to be lubricated. They are also available with lock-nut on sight fitting for tightening to mounting bracket and with a compression fitting for connection to copper or Neoprene tubing for use where it is not practical to mount oiler directly on bearing housing.

Wagner®
TRANSFORMERS
... the choice of leaders in industry

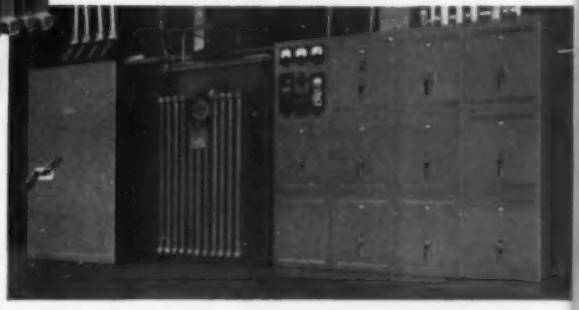
Wagner
UNIT SUBSTATION TRANSFORMERS

DESIGNED FOR PLANT POWER DISTRIBUTION SYSTEMS

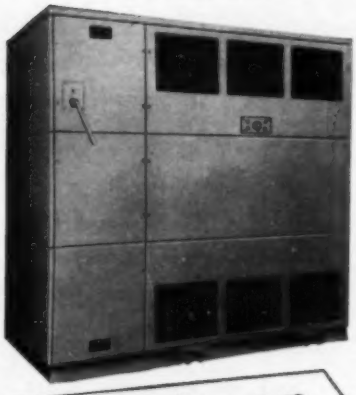


The ever-increasing demand for electric energy to power today's stepped-up production presents a critical problem. The answer to this problem has been found in load-center power distribution systems. The vital part of the load-center system is the transformer. If a switch or circuit breaker fails, only a part of the system is affected—but if the transformer fails, the entire system is dead.

Wagner Unit Substation Transformers assure a continuous, dependable flow of power. They are carefully designed to meet your distribution requirements, and are available with various types of entrances and controls for the high-voltage circuits, and with proper throats on the secondary side to connect to any make of switchgear, in the usual range of ratings up to 2000 kva.



Wagner-equipped unit substation in a synthetic textile plant.



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B-13 **RAILWAY CAR HANDLING**—Bulletin TM-104, 8 pages — "The Whiting Trackmobile" describes method of spotting, switching, and hauling railway cars; illustrated with applicational photographs. Construction features, table of performance, and dimensions are included.—WHITING CORPORATION, Harvey, Ill.

B-14 **PROCESS EQUIPMENT**—"Bondact Catalog"—Illustrates and describes process machine, the "Bondactor" for air placement of concrete, refractories, insulating concrete, acoustical plastics, and other cementitious materials in construction and maintenance operations.—AIR PLACEMENT EQUIPMENT COMPANY, 2525 Southwest Boulevard, Kansas City 8, Mo.

B-15 **WELDING**—Manual, 44 pages—"Manual of Welding Engineering and Design" covers latest developments in welding materials and techniques with special reference to applications for defense production and maintenance. Contains technical data on characteristics and operational procedures. — EUTECTIC WELDING ALLOYS CORPORATION, 40 Worth St., New York 13, N. Y.

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B-18 **MASONRY SURFACE MAINTENANCE**—Folder, 4 pages—Describes "Longlife", a heavy paste designed for protecting and preserving masonry and for steps in the operational process are plaster-bonding over masonry. Properties, method of applying, and recommended uses are included. Illustrated. — FLEXROCK COMPANY, Filbert and Cuthbert, West of 36th, Philadelphia 4, Pa.

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B-20 **PLASTIC FIRE BRICK**—Catalog, 44 pages—Discusses plastic fire brick, applications, specifications, special uses, engineering data, and installations. Covers metal and refractory anchors.—LACLEDE-CHRISTY COMPANY, Attn: J. S. Marsh, 200 Iroquois Bldg., 3600 Forbes St., Pittsburgh 13, Pa.

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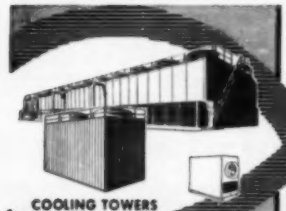

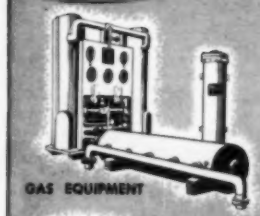

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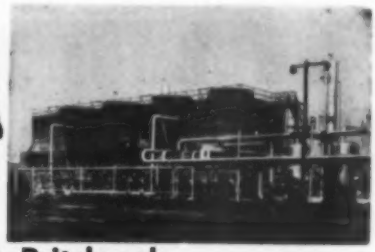

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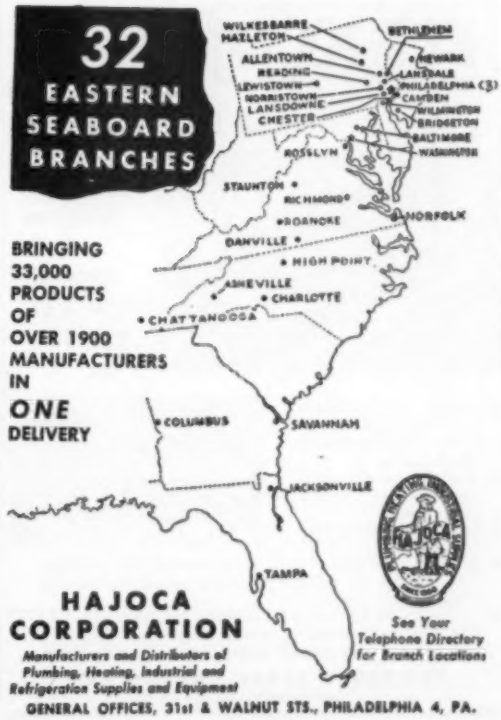

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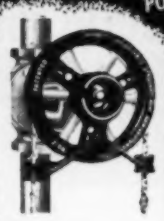

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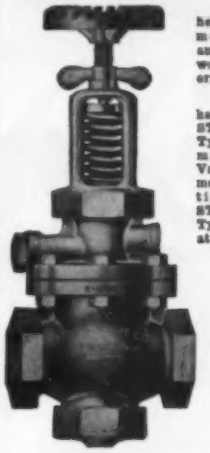

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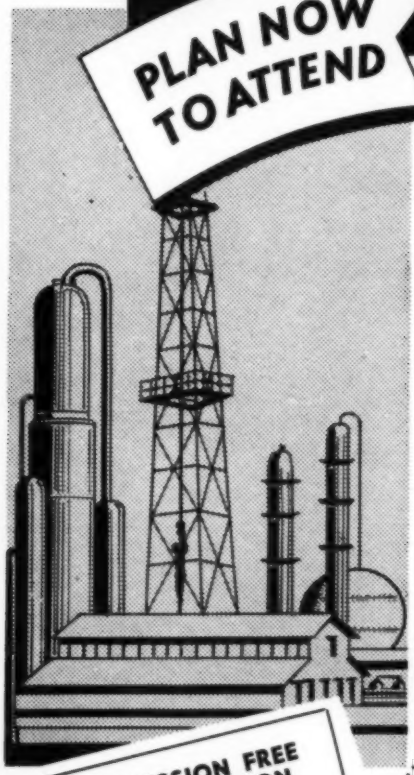

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